Saskatchewan
Watershed
Authority

STATE OF THE WATERSHED

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MASSACHUSETTS WATERSHED AUTHORITY

STATE OF THE WATERSHED

REPORT

MINISTER'S MESSAGE

Saskatchewan has a vast wealth of natural resources, and one of our most prized resources is our water. Saskatchewan's surface and ground water sources are vital to life in this province, not only as the supply of safe drinking water for our residents, but also as a key driver of economic activity.

As people who are proud to live and work in Saskatchewan, and as stewards of our shared environment, it is our responsibility to monitor and protect our water resources.

We need to manage our province's watersheds so that all Saskatchewan people have access to a dependable, high-quality supply of water. This is a complex task which requires that every level of government, the private sector, and individual stewards work together toward a common vision.

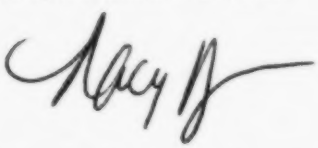
Our government has also committed to developing a comprehensive water management plan for Saskatchewan. This plan will set out an integrated provincial approach to ensuring a secure water supply for residential and commercial uses, both now and into the future.

I am very pleased to release the *2010 State of the Watershed Report* which is an important step in meeting these commitments. This report provides valuable information on the health of Saskatchewan's 29 watersheds. More importantly, the *State of the Watershed Report* allows us to make informed decisions at the local, watershed, and provincial level about our water.

The first *State of the Watershed Report* was released in 2007. This report is the second in an ongoing series, and is based on a framework that allows changes in watershed health to be tracked over time. As such, the *State of the Watershed Report* allows us to trace the success of policies and programs that have been put in place to manage and protect our water, and to identify areas in which we need to commit more effort and resources.

As you read through this document, you will notice that we have made a considerable number of improvements compared to the first report. In some cases, new data have become available and have been integrated into our assessments. In other cases, we have developed better methods of characterizing the natural processes at work in Saskatchewan's watersheds and the effects human activities have on them. For example, one key change made in this report is that the assessment of indicators has been modified to better reflect how water provides multiple services (such as drinking water, wildlife habitat, hydropower generation, and many others) to society and our natural environment. This new approach recognizes that our water resources are finite, and that the stress we place on them through our actions directly impacts the watershed's ability to provide those services. It will allow us to target specific actions to improve the health of our watersheds, and ultimately ensure that they can continue to deliver these valuable services.

Looking ahead, we will release the next *State of the Watershed Report* in five years. I look forward to working together during that period to further enhance our management of Saskatchewan's water resources, and to reporting on those successes in the future.



Honourable Nancy Heppner

EXECUTIVE SUMMARY

Why a *State of the Watershed Report*?

Water is the foundation for economic, social and environmental prosperity in Saskatchewan. It provides multiple services to society, including: provision of water supplies for people, irrigation, livestock, and industry; maintenance of a healthy environment; fish and wildlife habitat; hydropower generation; and recreational opportunities. Without proper management of this renewable resource the services it provides will be impacted, which will in turn reduce the growth potential of the province.

The collective management of these services (often referred to as Integrated Water Resource Management) maximizes the economic and social benefits that come from how we use our water resources, in a manner that does not compromise the sustainability of watershed ecosystems. Effective environmental policies, decision-making and management of our watersheds requires relevant, accessible, timely, understandable and scientifically-defensible information. To date, most data required for decision support have not been systematically converted into information. To address this critical gap, the Saskatchewan Watershed Authority adopted State of the Watershed Reporting.

Saskatchewan's *State of the Watershed Report* is a benchmark tool for assessing watershed health, and is intended to provide governments, decision-makers, industry and the community with the scientifically-defensible information needed to manage the province's water resources in an integrated fashion. The framework for this report is specifically designed to provide regular updates on watershed health, and to allow watershed health comparisons to be made among watersheds and within watersheds over time. This reporting system establishes a basis for making management decisions in the long-term interest of environmental sustainability.

How Watersheds are Assessed

The State of the Watershed Reporting process is based on a *Stress-Condition-Response* model, and uses indictor-based assessments to rate watershed health, environmental stressors, and management responses. The *Stress-Condition-Response* Model explicitly recognizes relationships between the health of the watershed (condition), human impacts on the ecosystem (stressors), and the associated management activities

Condition
Watershed condition: defined by both structure and function of the watershed, their health or status, and how they operate together (Ambient Monitoring, Background/Baseline Monitoring, Resource Inventories)
Air, soil, water and biota exposure (Ambient Monitoring)
MONITORING PYRAMID
Resistance and resilience of a system to disturbance (Effects and Cumulative Effects Monitoring)
Stress
Response
Management objectives for activities (Compliance Monitoring)
Activities producing stresses — Physical, chemical and biological stressors (Emission and Stressor Monitoring).
Recovery processes, societal response, agencies' responses (Performance Monitoring)

Figure 1. The *Stress-Condition-Response* Model.

(responses) that have been adopted to mitigate the stresses and improve the health of the watersheds.

The condition of Saskatchewan's watersheds is assessed using indicators that quantify critical aspects of water quality, as well as measurements of water quantity and riparian and rangeland health. The stress on Saskatchewan's watersheds is assessed using indicators related to population, water use, agriculture, and industry. And finally, responses are assessed based on such indicators as conservation efforts, education, stewardship, and planning and policy.

Individual indicators are given a rating to differentiate the conditions, stressors, and responses among watersheds. Each of these indicators is calculated using a Geographic Information Systems (GIS)-based platform, which enables the integration of spatially diverse data sources while providing easy-to-understand indicator maps as the end product.

As noted, the reporting process was also designed to provide regular updates on watershed health and to allow for the assessment of changes

within and among watersheds over time. The 2010 *State of the Watershed Report* is the second report in this series, and reports on a total of forty-one indicators. These indicators are consistent with those covered in previous reports, but have been updated to provide a more accurate and precise evaluation of the services water is providing at a watershed level.

One key change in this year's report is that the assessment of indicators using the *Stress-Condition-Response* Model has been modified to better reflect how water provides multiple services to society and our natural environment. Some examples of these services include:

- the provision of water supplies;
- maintaining ecosystem function;
- mitigating floods;
- mitigating droughts;
- recreational opportunities;
- hydropower generation;
- habitat for various wildlife species;
- supporting biodiversity; and
- source water protection.

Whenever water is used to provide these services, it places stress on the watershed. The major uses of water in Saskatchewan can be divided into five categories of stressors (Figure 2). Each of the stressor indicators included in this report are grouped according to these five categories. This new approach recognizes that water resources are finite and closely linked to ecological processes, and how they are influenced by the way they are used.

Figure 2. Watershed stressor categories.

In addition to assessing Saskatchewan's watersheds in the context of ecosystem services, the changes and improvements in this report compared to the previous report include:

- The adoption of a more appropriate descriptor for the lowest watershed health (condition) rating. In the 2007 *State of the Watershed Report*, the health of watersheds was classified into one of three categories: healthy, stressed or impaired. In this report, the health of watersheds is categorized as either healthy, stressed or impacted.
- The methods used to assess several indicators have been refined, based on additional information that was not included in the previous report.
- Only those condition indicators which have ecologically-based and scientifically-defensible rating schemes were used in calculating the watershed report card. As a result, the Permanent Cover indicator is no longer used to calculate the condition report card, as it currently does not have a rating scheme that is ecologically-based and scientifically-defensible.
- Two new condition indicators have been developed (the Ground Water Quality and Aquatic Benthic Macroinvertebrate Indicators).
- The Surface Water Quantity Indicator, which was included in the *2007 State of the Watershed Report* as a condition indicator, has been changed to a stressor indicator in this report. This change was made to better reflect how variations in surface water flow impact the amount of water available for various services.
- Stressor indicators are categorized into three classes: low intensity, moderate intensity and high intensity.
- Two new stressor indicators were developed (the Invasive Alien Species and Environmental Assessment Indicators).
- To improve their readability, the individual stressor indicator maps are now shaded based on the issue types. Water Uses indicators are shaded blue; Human Influences indicators are shaded yellow; Agricultural Influences indicators are shaded **green**; Natural Resource Extractions indicators are shaded **brown**; and Industrial Influences indicators are shaded gray. The shading is lightest where the intensity is low; medium where the intensity is moderate; darkest where the intensity is high; and white if there is a data gap or the data are not applicable for that watershed.
- Nine of the ten response indicators have rating schemes, compared to five of the ten response indicators in the 2007 Report.
- Trends, or changes over time, have been described for each of the condition indicators where data were available.

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- Nine of the ten response indicators have rating schemes, compared to five of the ten response indicators in the 2007 Report.
- Trends, or changes over time, have been described for each of the condition indicators where data were available.

2010 Condition, Stressor, and Response Ratings

Condition

To assess the health of watersheds in Saskatchewan, nine condition indicators were developed (see Appendix A). Of these nine indicators, six have ecologically-based and scientifically-defensible rating schemes that allow for comparative assessments of watershed health. Only the six condition indicators for which rating schemes have been developed were used in determining the overall health of each watershed.

The health of each of Saskatchewan's watersheds was categorized into one of three classes based on ecosystem services, ecosystem function, and the watershed's resistance and resilience to change: **healthy**, [illegible] or impacted. A watershed was rated as:

- **Healthy** - if the watershed has no apparent change in function or services provided by water, and the system is both resistant and resilient to change.
- [illegible] - if the watershed has no degradation in function and/or services it provides, but it has lost resistance to change.
- Impacted - if the watershed has a change and/or degradation in function and/or services.

The overall health of a watershed was determined using that watershed's lowest health rating from the six condition indicators. Therefore, a watershed is rated as impacted if at least one of the six condition indicators had a rating of impacted; stressed if the lowest rating for at least one of the six condition indicators had a rating of stressed; or healthy if all of the six condition indicators had a rating of healthy.

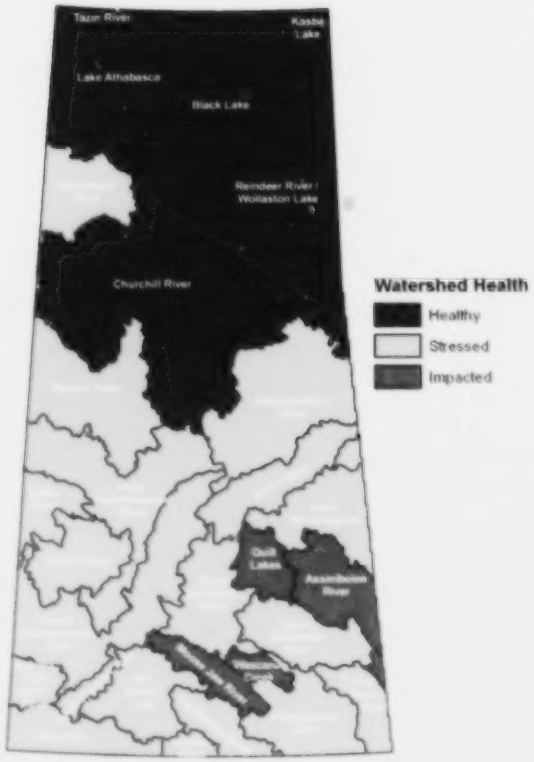


Figure 3. Health of watersheds based on condition indicators.

Based on this assessment, six of Saskatchewan's watersheds were identified as being **healthy**, 19 watersheds were identified as being [illegible], and four watersheds were identified as being impacted (Figure 3).

See Appendix A for a detailed assessment of condition indicators.

Stressors

To assess the potential stress of human activities on watersheds in Saskatchewan, 22 stressor indicators were developed (see Appendix B). Stressor indicators were designed to focus on five issues associated with human activities: water use, human population, agricultural influences, industrial influences, and natural resource extractions. Each of the stressor indicators have rating schemes that allow stress to be rated at the watershed level. All of the stressor indicators were weighted equally to provide means of assessing the overall stress on each watershed.

Each stressor on Saskatchewan's watersheds was categorized into three classes: low intensity, moderate intensity or high intensity. A watershed was rated as:

- Low intensity – if less than three of the 22 stressor indicators had a high intensity rating.
- Moderate intensity – if between three and five of the 22 stressor indicators had a high intensity rating.
- High intensity – if more than five of the 22 stressor indicators had a high intensity rating.

It should be noted that a specific intensity score may have little or no correlation with the health rating of a watershed. It is strictly a measure of activity on the landscape.

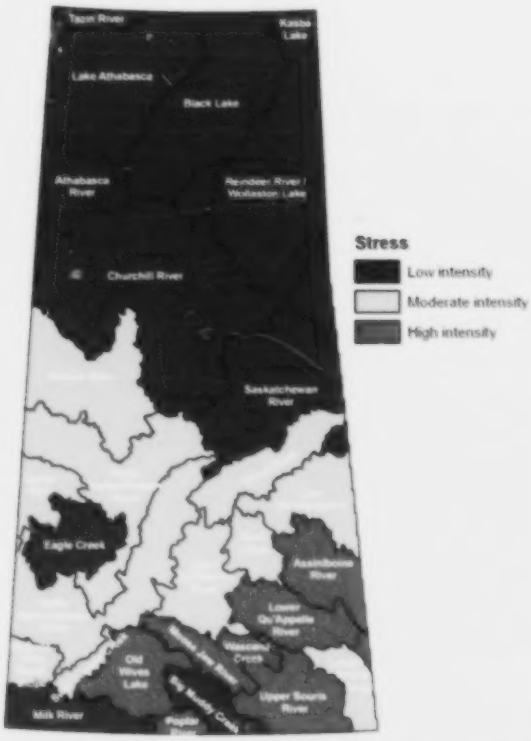


Figure 4. Stress rating of watersheds based on stressor indicators.

Based on this rating scheme, seven watersheds had a high intensity rating, 11 watersheds had a moderate intensity rating, and 11 watersheds had a low intensity rating (Figure 4).

To further understand the impact each stressor has on Saskatchewan's watersheds, a stressor footprint was developed. The stressor footprint provides information on the stress each indicator is potentially placing on watersheds in Saskatchewan, whereas the stressor report card (see Table 4 on page 28) provides information on the specific stress loads each watershed is receiving.

How to read the stressor footprint

The stressor footprint is a circular diagram divided into 22 segments, one for each of the 22 stressor indicators. Each indicator is weighted equally. The greater the coloured area of an indicator segment, the greater stress potential this indicator has on watersheds in Saskatchewan.

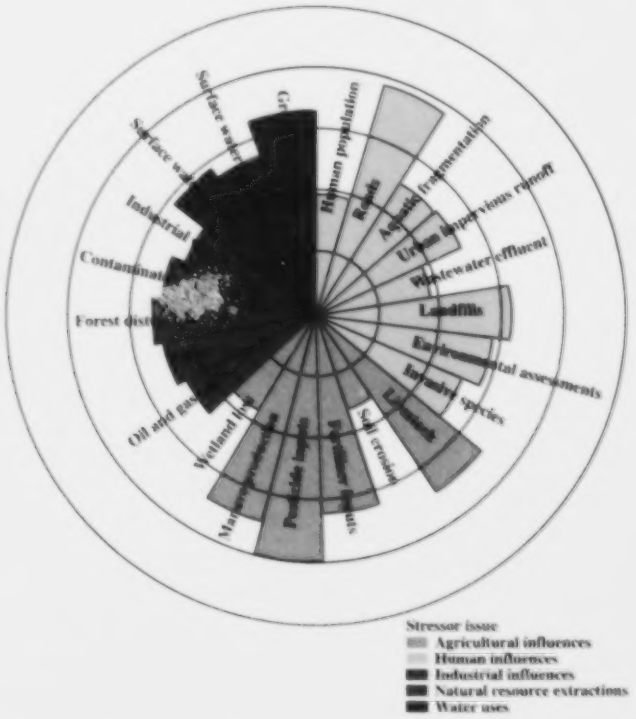


Figure 5. Stressor footprint.

According to the stressor footprint diagram (Figure 5) the ten stressor indicators that have the highest intensity and the greatest stress potential are the Pesticide Inputs, Roads, Livestock, Ground Water Use, Manure Application, Fertilizer Inputs, Landfills, Environmental Assessments, Surface Water Quantity, and Invasive Alien Species Indicators.

See Appendix B for a detailed assessment of the stressor indicators.

2010 Condition, Stressor, and Response Ratings

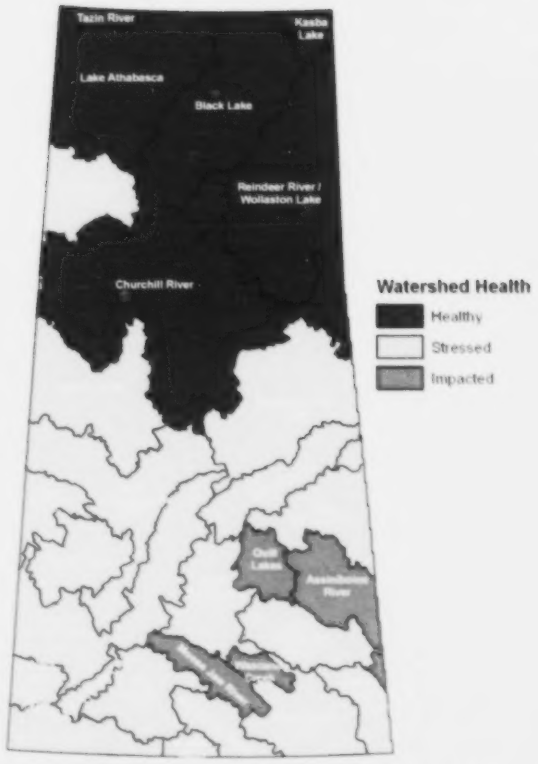
Condition

To assess the health of watersheds in Saskatchewan, nine condition indicators were developed (see Appendix A). Of these nine indicators, six have ecologically-based and scientifically-defensible rating schemes that allow for comparative assessments of watershed health. Only the six condition indicators for which rating schemes have been developed were used in determining the overall health of each watershed.

The health of each of Saskatchewan's watersheds was categorized into one of three classes based on ecosystem services, ecosystem function, and the watershed's resistance and resilience to change: healthy, or impacted. A watershed was rated as:

- Healthy - if the watershed has no apparent change in function or services provided by water, and the system is both resistant and resilient to change.
  - if the watershed has no degradation in function and/or services it provides, but it has lost resistance to change.
- Impacted - if the watershed has a change and/or degradation in function and/or services.

The overall health of a watershed was determined using that watershed's lowest health rating from the six condition indicators. Therefore, a watershed is rated as impacted if at least one of the six condition indicators had a rating of impacted; stressed if the lowest rating for at least one of the six condition indicators had a rating of stressed; or healthy if all of the six condition indicators had a rating of healthy.



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Each stressor on Saskatchewan's watersheds was categorized into three classes: low intensity, moderate intensity or high intensity. A watershed was rated as:

- Low intensity – if less than three of the 22 stressor indicators had a high intensity rating.
- Moderate intensity – if between three and five of the 22 stressor indicators had a high intensity rating.
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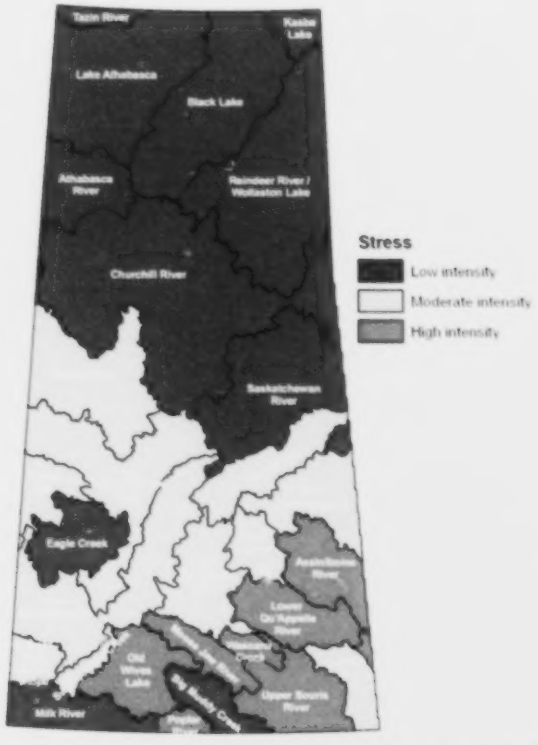
It should be noted that a specific intensity score may have little or no correlation with the health rating of a watershed. It is strictly a measure of activity on the landscape.



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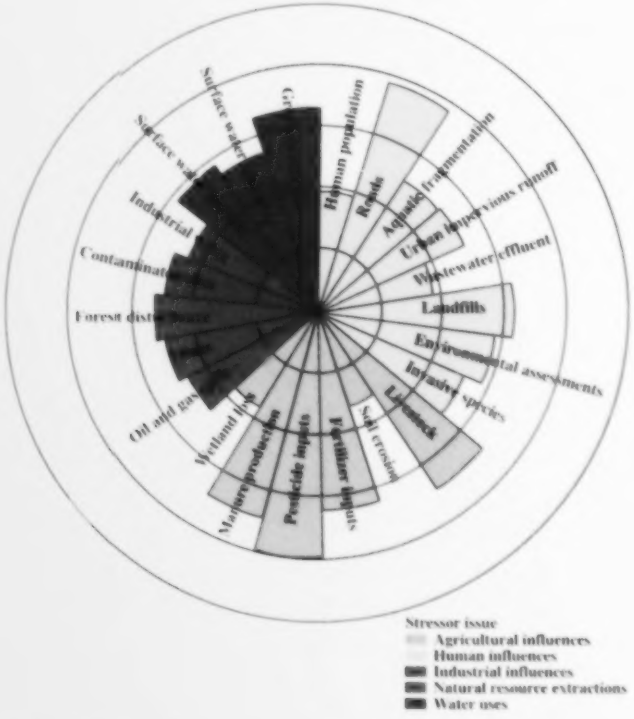

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See Appendix B for a detailed assessment of the stressor indicators.

Responses

To assess the management initiatives that have been adopted to mitigate stresses and improve the health of Saskatchewan's watersheds, ten response indicators were developed (see Appendix C). Of these ten indicators, nine had sufficient data to allow management responses to be rated at the individual watershed level. Regarding the only indicator for which sufficient data was not available (the Watershed Education Indicator) the involved organizations typically record information on a province-wide scale, preventing the summarization of information by watershed.

To categorize the response rating by watershed, the same rating scheme used in the 2007 *State of the Watershed Report* was employed. That is, each watershed was categorized as having a:

- Low response rating – if less than 50% of the response indicators were active/present within the watershed.
- Moderate response rating – if between 50% and 74% of the response indicators were active/present within the watershed.
- High response rating – if 75% or more of the response indicators were active/present within the watershed.

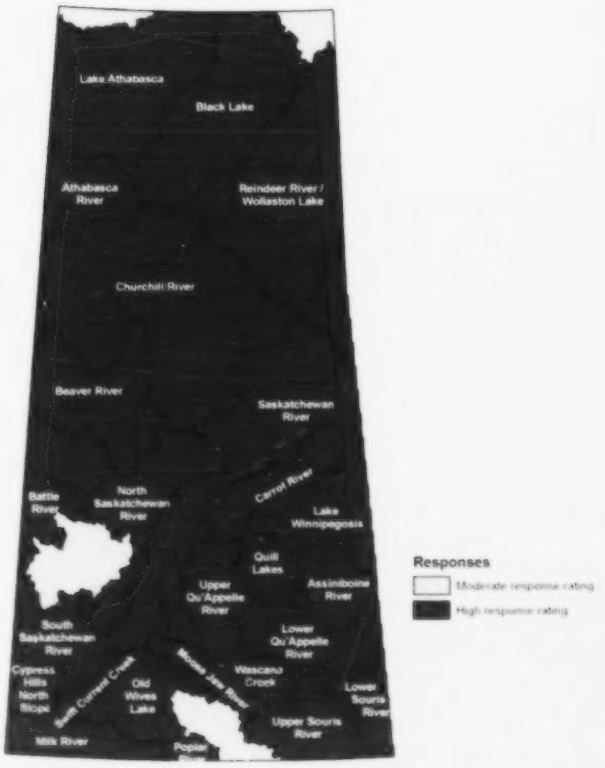

Figure 6. Response rating by watershed.

Based on this rating scheme, 25 of the 29 watersheds had a high response rating and four watersheds had a moderate response rating. The watersheds with the lowest response rating were the Big Muddy Creek, Eagle Creek, Kasba Lake, and Tazin River Watersheds.

See Appendix C for a detailed assessment of the response indicators.

Trends in the Health of Saskatchewan's Watersheds

The State of the Watershed Reporting process was designed to provide regular updates on watershed health and allow for the assessment of changes within and among watersheds over time. In the 2010 *State of the Watershed Report*, a number of core condition indicators from the 2007 *State of the Watershed Report* were revised and fine-tuned to provide a more accurate and precise evaluation of the ecological services water is providing at the watershed level. Due to these changes, the ratings for these indicators from the 2007 *State of the Watershed Report* cannot be directly compared to the ratings in this report. For this reason, trends in watershed health could not be analyzed by directly comparing the two reports.

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- Moderate response rating – if between 50% and 74% of the response indicators were active/present within the watershed.
- High response rating – if 75% or more of the response indicators were active/present within the watershed.

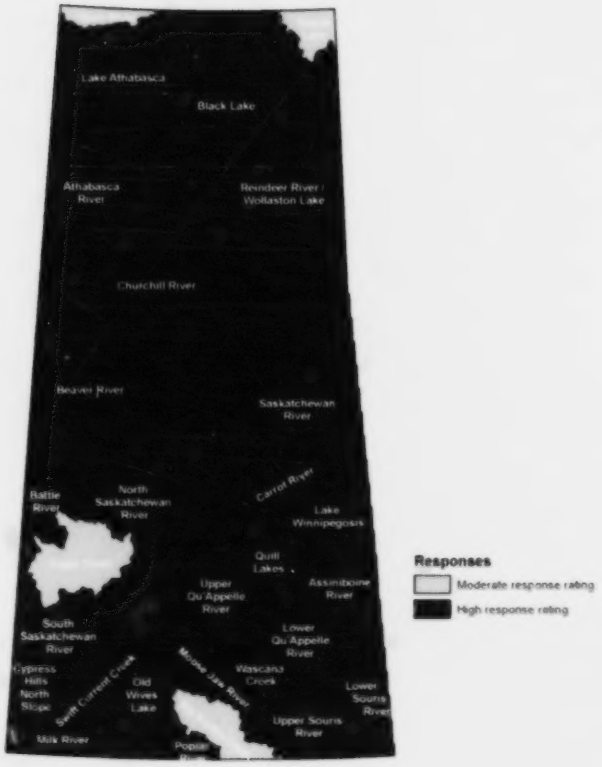

Figure 6. Response rating by watershed.

Based on this rating scheme, 25 of the 29 watersheds had a high response rating and four watersheds had a moderate response rating. The watersheds with the lowest response rating were the Big Muddy Creek, Eagle Creek, Kasba Lake, and Tazin River Watersheds.

See Appendix C for a detailed assessment of the response indicators.

Trends in the Health of Saskatchewan's Watersheds

The State of the Watershed Reporting process was designed to provide regular updates on watershed health and allow for the assessment of changes within and among watersheds over time. In the 2010 *State of the Watershed Report*, a number of core condition indicators from the 2007 *State of the Watershed Report* were revised and fine-tuned to provide a more accurate and precise evaluation of the ecological services water is providing at the watershed level. Due to these changes, the ratings for these indicators from the 2007 *State of the Watershed Report* cannot be directly compared to the ratings in this report. For this reason, trends in watershed health could not be analyzed by directly comparing the two reports.

Rather, trends in watershed health were analyzed by applying the revised methods to the most recent ten years of data (1999-2008). The data was then broken into two five-year increments (1999-2003 and 2004-2008). Using the same methodology to produce watershed health ratings for these indictors enabled the ratings for the two time periods to be directly compared to one another, and this made it possible to assess changes in watershed health over time.

The overall health ratings, as shown in the watershed report card beginning on page 29, remained constant for 27 of the 29 watersheds between 1999-2003 and 2004-2008. The Wascana Creek and Assiniboine River Watersheds are the two watersheds that had different health ratings between the two time periods. A more detailed explanation of trends in the health of Saskatchewan's watersheds between 1999-2003 and 2004-2008 can be found in Section 4.0 (see page 17).

Moving Forward

Looking ahead over the next few years, the Saskatchewan Watershed Authority will work to:

- improve the collection of environmental data in Saskatchewan so that data are collected in a consistent manner and addresses some of the data quality/caveat issues outlined in the *State of the Watershed Report;*
- continue to refine the indicators and the ranking framework based on expert opinion and feedback; and
- publish the *State of the Watershed Report* on a five-year basis to track changes in the indicators and the health of Saskatchewan's watersheds.

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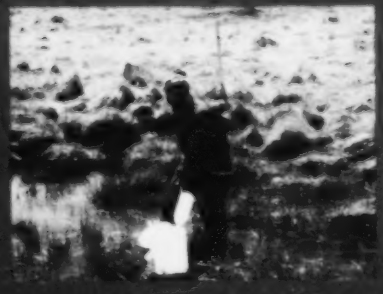
STATE OF

INTRODUCTION

Watersheds in Saskatchewan

"Saskatchewan is a tapestry made from a material drenched in water."

Terry Hanley, PhD
Director, Science, Information and Monitoring
Saskatchewan Watershed Authority



THE WATERSHED

1.0

Twelve percent of the surface of Saskatchewan is covered by water. This province has more prairie wetlands than any of the other prairie provinces combined, and comparable ground water resources to any Canadian province.

A watershed or drainage basin is a region that drains into a specific body of water, such as a river, lake, pond, or ocean. It includes all the land, air, plants and animals within its borders. Each watershed has a unique mixture of land and water habitats; from wetlands, rivers and lakes to forests, grasslands, farms, towns and cities. Land forms such as hills or other heights of land largely determine the boundaries of watersheds, as well as the speed and path of its rivers. Watersheds within Saskatchewan ultimately drain into one of three marine water bodies: the Arctic Ocean, Hudson Bay, or the Gulf of Mexico (Figure 7).

Saskatchewan has 14 major watersheds ranging from the tiny Tazin River and Kasba Lake Basins in the north to the immense Saskatchewan River Basin in central Saskatchewan to the Souris River Basin in the southeastern part of the province. For management purposes, the Saskatchewan Watershed Authority has divided these fourteen major watersheds into twenty-nine smaller watersheds (Figure 8).

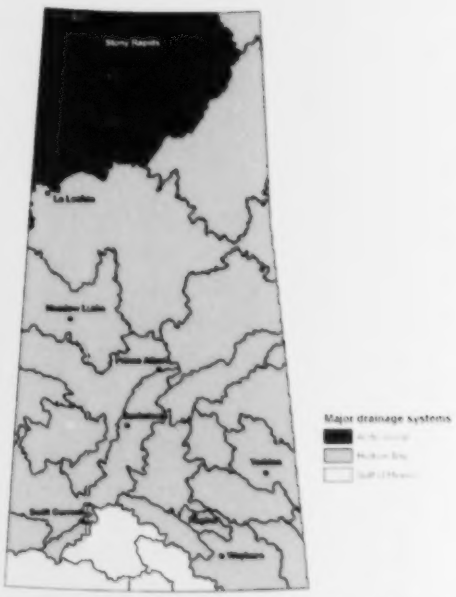


Figure 7. Saskatchewan's three major drainage systems.

Figure 8. Saskatchewan Watershed Authority's twenty-nine watersheds.

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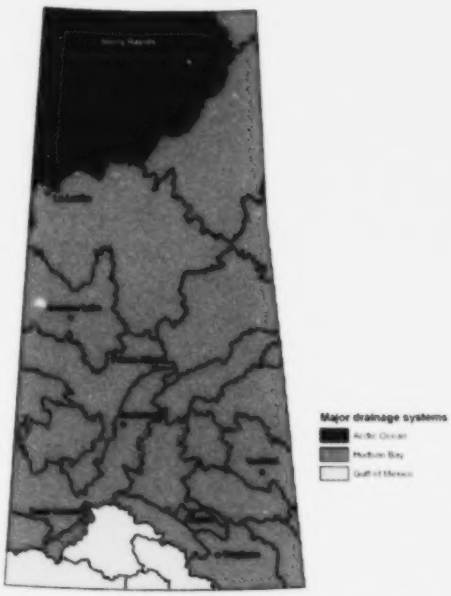

Figure 7. Saskatchewan's three major drainage systems.

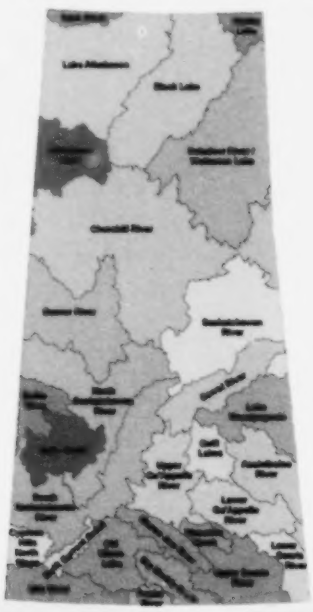

Figure 8. Saskatchewan Watershed Authority's twenty-nine watersheds.

State of the Watershed Reporting

The *State of the Watershed Report* provides a benchmark for assessing watershed health in Saskatchewan. It is a key management tool for protecting our water resources to ensure high water quality and sufficient water supplies. The specific objectives of this report are to assess the current health of watersheds (conditions), to provide information about human activities that impact the environment within watersheds (stressors), and to evaluate the effectiveness of management activities designed to mitigate the stressors and improve the condition of the watersheds (responses).

The format and content of this report are a reflection of its target audiences. Various audiences desire different levels of information, ranging from technically detailed to general summaries. The target audience for the *State of the Watershed Report* spans this range and includes:

- provincial and federal government departments;
- researchers;
- municipalities;
- industry;
- interest groups; and
- the general public.

The format and content of this report was developed by experts from the Saskatchewan Watershed Authority and by an external technical review panel drawn from several government and non-government organizations, including the Saskatchewan Ministry of Environment, the Saskatchewan Ministry of Agriculture, the Saskatchewan Ministry of Energy and Resources, Environment Canada, and Ducks Unlimited Canada.

The *State of the Watershed Report* is based on information available from the Saskatchewan Watershed Authority and other government and non-government organizations. The range of data and the data sources that were used have enabled the production of a comprehensive report containing the most up-to-date information available.

The *State of the Watershed Report* is an indicator-based assessment with a rating system for each indicator. Data were assessed against rating schemes and, using geographical information Systems (GIS)-based technology, easy-to-understand maps were produced highlighting the stressors and conditions of Saskatchewan's watersheds. The rating system allows for regular reporting on watershed conditions in order to assess changes in watershed health and identify the principal issues that have the potential to affect the health of the watershed. Therefore, the framework for this report is specifically designed to allow watershed health comparisons to be made among watersheds and within watersheds over time. This reporting system will provide a basis for governments, decision-makers and the community to act in the long-term interest of environmental sustainability.

STATE OF

WATERSHED REPORT CARD FRAMEWORK

The watershed report card communicates an evaluation of the health of watersheds in Saskatchewan. It consists of a number of essential attributes; specifically, it:

- *is based on a model of a watershed that explicitly recognizes relationships between the health of the watershed (condition), impacts on the watershed, human activities (stressors), and associated management activities (responses). It also reflects how we look at the watershed (structure and function) in the context of source protection;*
- *assesses progress in an integrated manner towards the provincial government's water management goals and the Saskatchewan Watershed Authority's corporate, program and planning/operational goals, being both relevant and the decision-supportive for all target audiences;*
- *provides a context for the development of indicators and associated monitoring plans in a practical, achievable and affordable manner; and*
- *provides a logical rating system to assess stressors, watershed health and responses.*

THE WATERSHED

2.0

The watershed report card is based on a model of a watershed that explicitly recognizes relationships between the health of the watershed (condition), impacts on the watershed, human activities (stressors), and associated management activities (responses). It also reflects how we look at watersheds (structure and function) in the context of source protection.

A conceptual model of watershed function is necessary to effectively relate human activity with ecosystem health. The premise behind such a model is that a human activity can impose a stress that may impact the condition of the watershed, which requires a management response to counteract the stress. The *Stress-Condition-Response* Model is presented in Figure 9.

In addition to providing a template on which to base watershed monitoring, assessment and reporting, the *Stress-Condition-Response* Model:

- links stress, due to specific activities, with watershed responses, forming the basis for watershed planning;
- links management activities and monitoring to provide a more comprehensive approach to watershed management;
- relates all aspects of watershed monitoring (i.e. stresses lead to changes in watershed condition and responses aim to relieve stresses and improve condition);
- identifies data gaps and areas where future resources and effort should be focused, including increased understanding of critical thresholds at which ecosystems become impacted and their ability to function is lost; and
- provides a context for the development of indices/indicators to characterize risks, watershed conditions or management issues in a meaningful way for users.

The watershed report card assesses progress in an integrated manner toward the Saskatchewan Watershed Authority's corporate, program and toward the provincial government's water management goals and the planning/operational goals, being both relevant and decision-supportive for all target audiences.

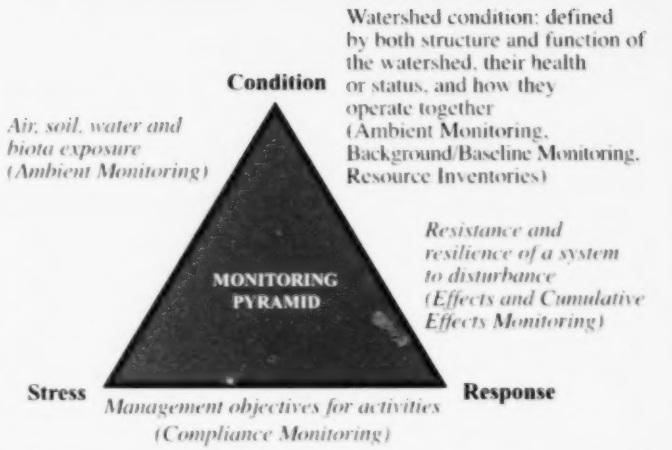
Condition
Watershed condition: defined by both structure and function of the watershed, their health or status, and how they operate together (Ambient Monitoring, Background/Baseline Monitoring, Resource Inventories)
Air, soil, water and biota exposure (Ambient Monitoring)
Resistance and resilience of a system to disturbance (Effects and Cumulative Effects Monitoring)
MONITORING PYRAMID
Stress
Response
Management objectives for activities (Compliance Monitoring)
Activities producing stresses — Physical, chemical and biological stressors (Emission and Stressor Monitoring).
Recovery processes, societal response, agencies' responses (Performance Monitoring)

Figure 9. *Stress-Condition-Response* Model demonstrating the relationship between various watershed health components.

The impetus of watershed reporting is to assess and measure progress from an overall government view, both from a corporate perspective and on the planning level, for the major watersheds within the province. This ongoing assessment provides governments, decision-makers and the community with the information needed to effectively manage the province's water resources in an integrated fashion.

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The watershed report card is based on a model of a watershed that explicitly recognizes relationships between the health of the watershed (condition), impacts on the watershed, human activities (stressors), and associated management activities (responses). It also reflects how we look at watersheds (structure and function) in the context of source protection.

A conceptual model of watershed function is necessary to effectively relate human activity with ecosystem health. The premise behind such a model is that a human activity can impose a stress that may impact the condition of the watershed, which requires a management response to counteract the stress. The *Stress-Condition-Response* Model is presented in Figure 9.

In addition to providing a template on which to base watershed monitoring, assessment and reporting, the *Stress-Condition-Response* Model:

- links stress, due to specific activities, with watershed responses, forming the basis for watershed planning;
- links management activities and monitoring to provide a more comprehensive approach to watershed management;
- relates all aspects of watershed monitoring (i.e. stresses lead to changes in watershed condition and responses aim to relieve stresses and improve condition);
- identifies data gaps and areas where future resources and effort should be focused, including increased understanding of critical thresholds at which ecosystems become impacted and their ability to function is lost; and
- provides a context for the development of indices/indicators to characterize risks, watershed conditions or management issues in a meaningful way for users.

The watershed report card assesses progress in an integrated manner toward the Saskatchewan Watershed Authority's corporate, program and toward the provincial government's water management goals and the planning/operational goals, being both relevant and decision-supportive for all target audiences.

Watershed condition: defined by both structure and function of the watershed, their health or status, and how they operate together (Ambient Monitoring, Background/Baseline Monitoring, Resource Inventories)
Condition
Air, soil, water and biota exposure (Ambient Monitoring)
Resistance and resilience of a system to disturbance (Effects and Cumulative Effects Monitoring)
MONITORING PYRAMID
Stress
Response
Management objectives for activities (Compliance Monitoring)
Activities producing stresses — Physical, chemical and biological stressors (Emission and Stressor Monitoring).
Recovery processes, societal response, agencies' responses (Performance Monitoring)

Figure 9. *Stress-Condition-Response* Model demonstrating the relationship between various watershed health components.

The impetus of watershed reporting is to assess and measure progress from an overall government view, both from a corporate perspective and on the planning level, for the major watersheds within the province. This ongoing assessment provides governments, decision-makers and the community with the information needed to effectively manage the province's water resources in an integrated fashion.

In the Spring of 2008, the Government of Saskatchewan put forward its vision for a secure and prosperous Saskatchewan, leading the country in economic and population growth, while providing opportunity for a high quality of life for all. At the same time, Government set three goals for all Ministries and agencies to work toward, to ensure that the work government does is aligned with a common vision. The second of those goals is to secure Saskatchewan as a safe place to live and raise a family where people are confident in their future, ensuring the people of Saskatchewan benefit from the growing economy. In keeping with this goal, one of the Saskatchewan Watershed Authority's core strategies is to manage watersheds to meet aquatic ecosystem and fish habitat needs. As managing the province's watersheds inherently implies the need to understand their current condition, preparing and publishing the *State of the Watershed Report* is a key action supporting that strategy.

The watershed report card provides a context for the development of indicators and associated monitoring plans in a practical, achievable and affordable manner.

Indicators are the tools of the *State of the Watershed Report*. They characterize the issues in a meaningful way. Indicators are a reflection of the environmental and resource management questions, whether those questions relate to ecosystem health, Ministerial progress or specific regional concerns. They may be quantitative, descriptive, projective or predictive in nature. Indicators may include information from a combination of several variables. They allow more simplified analysis of complex ecological functions.

The goal of using indicators and indices is to effectively summarize and communicate the status of complex ecological systems using a form that is appropriate for water management applications and public understanding. For State of the Watershed Reporting, the Saskatchewan Watershed Authority is using a series of indicators in the context of the *Stress-Condition-Response* Model. The indicators have a number of key features, including:

- they quantify information such that its importance is more apparent;
- they use existing information;
- they simplify information from complex ecosystems to improve communication with the public and with decision-makers;
- they are a cost-effective and representative alternative to monitoring infinite individual processes; and
- they can be implemented and updated in an appropriate time frame for the State of the Watershed Reporting.

The watershed report card provides a logical rating system to assess stressors, watershed health and responses.

A review of the scientific literature was conducted to find logical and appropriate rating schemes for the stressor, condition and response indicators. All condition indicators have ecologically-based and scientifically defensible rating schemes to allow for comparative assessments of watershed health.

Based on the above assessment methods, the following rating schemes were used:

Condition indicators were classified into three classes - **Healthy**, Stressed and Impacted.

- The condition indicator is shown as green on the Saskatchewan watershed map when the condition of the watershed is healthy; orange when the watershed is stressed; red when the watershed is impacted; and white if there is a data gap or the data are not applicable for that watershed. Therefore, we define a watershed as:
  - **Healthy** - if the watershed has no apparent change in function or services provided by water, and the system is both resistant and resilient to change.
  - Stressed - if the watershed has no degradation in function and/or services it provides.

- Impacted - if the watershed has a change and/or degradation in function and/or services.

See Appendix A for a detailed assessment of the condition indicators.

Stressor indicators were classified into three classes – Low Intensity, Moderate Intensity and High Intensity. When insufficient data from appropriate scientific studies existed to rate stressor indicators, the Jenks' optimization method was used to find the natural breaks in the data. This method minimizes within-class sum of squared differences between observed values within each class and class means, while maximizing the sum of squared differences between the classes. The results of the Jenks' optimization method may change as more data are included. A Low Intensity rating simply means that the watershed scored lower relative to other watersheds in Saskatchewan based on the criteria being rated. Stress ratings are relative measures and are designed to provide information on the potential intensity levels of the activity in the watershed, relative to other watersheds in the province.

- The stressor indicators are shaded based on the five ecosystem services categories: Waters Uses indicators are shaded blue; Human Influences indicators are shaded yellow; Agricultural Influences indicators are shaded **green**; Natural Resources Extractions indicators are shaded **brown**; and Industrial Influences indicators are shaded gray. The shading is lightest on the Saskatchewan watershed map when the intensity is low; medium when the intensity is moderate; darkest when the intensity is high; and white if there is a data gap or the data are not applicable for that watershed.

It is important to note that the stressor rating does not reflect the health of a watershed. The existence of a stress does not mean that the health of the watershed is impacted; it implies that there is a potential for it to be impacted. Stress levels are all relative; therefore, a low intensity rating implies that, relative to other watersheds, the intensity is lower.

See Appendix B for a detailed assessment of the stressor indicators.

Response indicators were classified as Present or Absent.

- The response indicator is shown as green on the Saskatchewan watershed map when there is an appropriate response to mitigate the stress and improve the condition, and white if there is no appropriate response or if there is a data gap.

See Appendix C for a detailed assessment of the response indicators.

Indicators of watershed health are grouped into the *Stress-Condition-Response* Model. The condition section indicates the impacts of stressors on watershed health and the capacity of the watershed to buffer those stressors. The stressor section outlines how the resources in the watershed are used and summarizes the magnitude and trend of the major parameters influencing the condition. The response section outlines the management decisions that have been made to address source water protection and watershed health. The intent of the *State of the Watershed Report* is to link watershed management activities by organizations such as the provincial government, municipalities, and stewardship groups with the stressors and conditions of the watersheds.

Table 1. Select criteria to assign watershed health grades to Stressor, Condition, and Response indicators.

Condition Indicators	Indicator Descriptions	Impacted	Stressed	Healthy
Water Quality	The Water Quality Indicator is an assessment of the chemical, biological and physical constituents within the water.	< 45	45 to 79	80 to 100
Ground Water Quantity	The Ground Water Quality indicator measures the percentage of ground water wells that exceed human-influenced Maximum Acceptable Concentrations.	> 50%	> 0% to ≤ 50%	0%
Aquatic Benthic Macroinvertebrates	The Aquatic Benthic Macroinvertebrates Indicator assesses the health of aquatic benthic macroinvertebrates in Saskatchewan.	≤ 10%	11% to 89%	≥ 90%
Riparian Health	The Riparian Health Indicator measures the ability of a riparian area to perform the essential functions of trapping sediment, filtering runoff, stabilizing streambanks, recharging ground water, and providing wildlife habitat.	< 60%	60% to 79%	80% to 100%
Riparian Buffer	Riparian Buffer is the percent of permanent cover within a 40 metre strip of the adjacent waterway.	< 25%	25% to 74%	75% to 100%
Rangeland Health	The Rangeland Health Indicator measures the ability of a rangeland to perform the essential functions of reducing soil erosion, increasing water infiltration and reducing runoff.	< 50%	50% to 74%	75% to 100%
Environmental Acid Deposition	This indicator measures the exceedance of critical load of atmospheric sulphur and nitrogen deposition.		> 0 eq/ha/yr	≤ 0 eq/ha/yr

Table 1. Select criteria to assign watershed health grades to Stressor, Condition, and Response indicators (cont'd).

Stressor Indicators	Indicator Descriptions	High Intensity	Moderate Intensity	Low Intensity
Surface Water Quantity	The Surface Water Quantity Indicator compares the difference between the average natural flow regime to the average actual flow by watershed.	< 70%	70% to 94% or more than 100%	95% to 100%
Surface Water Allocation	The Surface Water Allocation Indicator assesses the percentage of the natural surface water flow that is allocated within each watershed.	> 40%	20% to 40%	< 20%
Density of Ground Water Wells	The Density of Ground Water Wells Indicator measures the density of ground water wells by watershed area.	> 0.37 wells/km²	0.16 to 0.37 wells/km²	< 0.16 wells/km²
Ground Water Allocation	The Ground Water Allocation Indicator estimates the amount of ground water that is allocated from each watershed.	> 1,289,977 litres/km²	367,154 to 1,289,977 litres/km²	< 367,154 litres/km²
Human Population Size	The Human Population Size Indicator is the number and distribution of people that reside in Saskatchewan.	> 113,100 people	31,900 to 113,100 people	< 31,900 people
Numerical Change in Human Population	The Numerical Change in Human Population Indicator is the change in the number and distribution of people that resided in the watershed between 1991 and 2001.	> 3,900 people	400 to 3,900 people	< 400 people
Human Population Density	The Human Population Density Indicator is a measurement of the number of people per square kilometre.	> 6.70 people/km²	2.60 to 6.70 people/km²	< 2.70 people/km²
Road Density	This indicator measures the density of roads within each watershed.	> 4.66 km/km²	1.50 to 4.66 km/km²	< 1.5 km/km²
Aquatic Fragmentation	The Aquatic Fragmentation Indicator identifies the proportion of stream segments unfragmented by dams and low-level crossings.	< 34%	34% to 68%	> 67%
Potential Runoff from Urban Impervious Areas	The Potential Runoff from Urban Impervious Areas Indicator estimates the maximum percentage of annual flow that is associated with runoff from urban impervious areas.	> 20%	2% to 20%	< 2%
Municipal Wastewater Effluent Discharge	This indicator measures the percentage of recorded flow that can be attributed to wastewater effluent discharge.	> 14%	4% to 14%	< 4%
Density of Landfills	This indicator measures the density of landfills per 1,000 square kilometres.	> 2.63 landfills/1,000 km²	1.40 to 2.63 landfills/1,000 km²	< 1.40 landfills/1,000 km²
Environmental Assessments	This indicator identifies the density of environmental assessments and screenings in Saskatchewan.	> 3.02 /1,000 km²	1.05 to 3.02 /1,000 km²	< 1.05 /1,000 km²
Invasive Alien Species	This indicator was designed to identify the stress invasive species are placing on watersheds.	> 16	2 to 16	< 2
Livestock Density	This indicator measures the density of livestock per square kilometre.	> 9 AUEs/100 ha	6 to 9 AUEs/100 ha	1 to 5 AUEs/100 ha
Livestock Operations	This indicator assesses the potential risk that livestock operations pose to source water.	> 426	214 to 426	< 214
Soil Erosion (tonnes/hectare/year)	The Soil Erosion Indicator is an estimate of the potential of soil erosion on cropped land caused by precipitation and surface runoff.	> 22 tonnes/ hectare/yr	11 to 22 tonnes/ hectare/yr	< 11 tonnes/ hectare/yr

Table 1. Select criteria to assign watershed health grades to Stressor, Condition, and Response indicators.

Condition Indicators	Indicator Descriptions	Impacted	Stressed	Healthy
Water Quality	The Water Quality Indicator is an assessment of the chemical, biological and physical constituents within the water.	< 45	45 to 79	80 to 100
Ground Water Quantity	The Ground Water Quality indicator measures the percentage of ground water wells that exceed human-influenced Maximum Acceptable Concentrations.	> 50%	> 0% to ≤ 50%	0%
Aquatic Benthic Macroinvertebrates	The Aquatic Benthic Macroinvertebrates Indicator assesses the health of aquatic benthic macroinvertebrates in Saskatchewan.	≤ 10%	11% to 89%	≥ 90%
Riparian Health	The Riparian Health Indicator measures the ability of a riparian area to perform the essential functions of trapping sediment, filtering runoff, stabilizing streambanks, recharging ground water, and providing wildlife habitat.	< 60%	60% to 79%	80% to 100%
Riparian Buffer	Riparian Buffer is the percent of permanent cover within a 40 metre strip of the adjacent waterway.	< 25%	25% to 74%	75% to 100%
Rangeland Health	The Rangeland Health Indicator measures the ability of a rangeland to perform the essential functions of reducing soil erosion, increasing water infiltration and reducing runoff.	< 50%	50% to 74%	75% to 100%
Environmental Acid Deposition	This indicator measures the exceedance of critical load of atmospheric sulphur and nitrogen deposition.		> 0 eq/ha/yr	≤ 0 eq/ha/yr

Table 1. Select criteria to assign watershed health grades to Stressor, Condition, and Response indicators (cont'd).

Stressor Indicators	Indicator Descriptions	High Intensity	Moderate Intensity	Low Intensity
Surface Water Quantity	The Surface Water Quantity Indicator compares the difference between the average natural flow regime to the average actual flow by watershed.	< 70%	70% to 94% or more than 100%	95% to 100%
Surface Water Allocation	The Surface Water Allocation Indicator assesses the percentage of the natural surface water flow that is allocated within each watershed.	> 40%	20% to 40%	< 20%
Density of Ground Water Wells	The Density of Ground Water Wells Indicator measures the density of ground water wells by watershed area.	> 0.37 wells/km²	0.16 to 0.37 wells/km²	< 0.16 wells/km²
Ground Water Allocation	The Ground Water Allocation Indicator estimates the amount of ground water that is allocated from each watershed.	> 1,289,977 litres/km²	367,154 to 1,289,977 litres/km²	< 367,154 litres/km²
Human Population Size	The Human Population Size Indicator is the number and distribution of people that reside in Saskatchewan.	> 113,100 people	31,900 to 113,100 people	< 31,900 people
Numerical Change in Human Population	The Numerical Change in Human Population Indicator is the change in the number and distribution of people that resided in the watershed between 1991 and 2001.	> 3,900 people	400 to 3,900 people	< 400 people
Human Population Density	The Human Population Density Indicator is a measurement of the number of people per square kilometre.	> 6.70 people/km²	2.60 to 6.70 people/km²	< 2.70 people/km²
Road Density	This indicator measures the density of roads within each watershed.	> 4.66 km/km²	1.50 to 4.66 km/km²	< 1.5 km/km²
Aquatic Fragmentation	The Aquatic Fragmentation Indicator identifies the proportion of stream segments unfragmented by dams and low-level crossings.	< 34%	34% to 68%	> 67%
Potential Runoff from Urban Impervious Areas	The Potential Runoff from Urban Impervious Areas Indicator estimates the maximum percentage of annual flow that is associated with runoff from urban impervious areas.	> 20%	2% to 20%	< 2%
Municipal Wastewater Effluent Discharge	This indicator measures the percentage of recorded flow that can be attributed to wastewater effluent discharge.	> 14%	4% to 14%	< 4%
Density of Landfills	This indicator measures the density of landfills per 1,000 square kilometres.	> 2.63 landfills/1,000 km²	1.40 to 2.63 landfills/1,000 km²	< 1.40 landfills/1,000 km²
Environmental Assessments	This indicator identifies the density of environmental assessments and screenings in Saskatchewan.	> 3.02 /1,000 km²	1.05 to 3.02 /1,000 km²	< 1.05 /1,000 km²
Invasive Alien Species	This indicator was designed to identify the stress invasive species are placing on watersheds.	> 16	2 to 16	< 2
Livestock Density	This indicator measures the density of livestock per square kilometre.	> 9 AUEs/100 ha		1 to 5 AUEs/100 ha
Livestock Operations	This indicator assesses the potential risk that livestock operations pose to source water.	> 426		< 214
Soil Erosion (tonnes/hectare/year)	The Soil Erosion Indicator is an estimate of the potential of soil erosion on cropped land caused by precipitation and surface runoff.	> 22 tonnes/ hectare/yr		< 11 tonnes/ hectare/yr

Table 1. Select criteria to assign watershed health grades to Stressor, Condition, and Response indicators (cont'd).

Stressor Indicators	Indicator Description	High Intensity	Moderate Intensity	Low Intensity
Fertilizer Inputs (kg N/ha)	The Fertilizer Inputs Indicator measures the relative rate of nitrogen applied as commercial fertilizer by watershed between 2001 and 2006.	> 45.50 kg N/ha	31.26 to 45.50 kg N/ha	< 31.26 kg N/ha
Fertilizer Inputs (kg P/ha)	The Fertilizer Inputs Indicator measures the relative rate of phosphorus applied as commercial fertilizer by watershed between 2001 and 2006.	> 8.50 kg P/ha	5.95 to 8.50 kg P/ha	< 5.95 kg P/ha
Pesticide Inputs	The Pesticide Inputs Indicator measures the intensity of pesticide use by watershed between 2001 and 2006.	> $49.71/hectare	$39.35 to $49.71 /hectare	< $39.35/ hectare
Density of Pesticide Permits	This indicator measures the density of pesticide permits issued between April 1, 2008 and March 31, 2009, by the Saskatchewan Ministry of Agriculture within each watershed.	> 19	4 to 19	< 4
Total Manure Production by Livestock	This indicator measures the total amount of manure produced by watershed.	> 1,628 kg/ha	1,098 to 1,628 kg/ha	< 1,098 kg/ha
Nitrogen production in Livestock Manure	This indicator measures the amount of nitrogen produced in livestock manure by watershed.	> 9.99 kg/ha	7 to 9.99 kg/ha	< 7 kg/ha
Phosphorus Production in Livestock Manure	This indicator measures the amount of phosphorus produced in livestock manure by watershed.	> 2.99	2 to 2.99 kg/ha	< 2 kg/ha
Wetland Loss	This indicator estimates the area of wetland loss by watershed between 1985 and 1999.	> 14%	5% and 14%	< 5%
Density of Oil and Gas Spills	The Density of Oil and Gas Spills Indicator is a measurement of the annual number of oil and gas spills per 1,000 square kilometres.	≥ 5 spills/1,000 km²	1 to 4spills/1,000 km²	< 1 spills/1,000 km²
Annual Volume of Oil and Emulsion Spills	The Volume of Oil and Emulsion Spills Indicator is a measure of the average annual volume of oil and emulsion spills per square kilometre.	> 100 litres/km²	10 to 100 litres/km²	< 10 litres/km²
Annual Volume of Saltwater Spills	This indicator measures the average annual volume of saltwater spills per square kilometre.	> 100 litres/km²	10 to 100 litres/km²	< 10 litres/km²
Mine Density	This indicator compares the density of active, inactive and abandoned mines within and between watersheds.	> 10 mines/1,000 km²	3 to 10 mines /1,000 km²	< 3 mines/1,000 km²
Potential Environmental Risk of Mines	This indicator measures the stress that active, inactive and abandoned mines are placing on the environment.	> 10	3 to 10	< 3
Percent of Forested Area Disturbed in Last 14 Years	This indicator measures the percent of forested area that has been disturbed by human activities and wildfire within watersheds over the past 14 years (1994-2007).	> 46.48%	18.67% to 46.48%	< 18.67%
Environmental Risk of Contaminated Sites	This indicator measures the stress that contaminated sites are placing on the environment.	> 7.89	2.72 to 7.89	< 2.72
Density of Industrial Waste Sites	This indicator measures the number of industrial waste sites per 1,000 square kilometres.	> 3.38/1,000 km²	1.20 to 3.38 /1,000 km²	< 1.20 /1,000 km²
Industrial Waste Disposed and Released	This indicator measures the tonnes of pollutants disposed of and released from industrial waste sites per square kilometre in Saskatchewan.	> 5.45 tonnes/km²	1.48 to 5.45 tonnes/km²	< 1.48 tonnes/km²

Table 1: Selected criteria and indicators for health guides to ... or, Condition, and Response indicators (cont'd).

Response Indicators	Indicator Descriptions	Absent/Gap	Present
Water Conservation	This indicator reports on the water conservation methods employed within Saskatchewan.	Yes	Yes
Conservation Stewards	This indicator reports on the number of volunteer stewards within a watershed.	Yes	Yes
Stewardship Workshops	This indicator reports on the number of stewardship workshops per watershed.	Yes	Yes
Beneficial Management Practices	This indicator outlines the Beneficial Management Practices that have been funded or adopted by watershed.	Yes	Yes
Watershed and Land Use Planning	This indicator assesses land use planning activities by watershed.	Yes	Yes
Water Quality Monitoring and Management	This indicator reports on the government-led water quality monitoring programs that are active by watershed.	Yes	Yes
Water Quantity Monitoring and Management	This indicator reports on the government-led water quantity monitoring programs that are active by watershed.	Yes	Yes
Protected Areas	This indicator reports on the percent of protected area by watershed.	Yes	Yes
Legislative Tools, Strategies, Policies, and Guidelines	This indicator reports on the federal and provincial legislation, strategies, policies and guidelines that have been developed to address environmental issues in Saskatchewan.	Yes	Yes

For detailed assessments of the condition, stressor and/or response indicators, see Appendices A, B, and C, respectively.

Table 1. Select criteria to assign watershed health grades to Stressor, Condition, and Response indicators (cont'd).

Stressor Indicators	Indicator Descriptions	High Intensity	Moderate Intensity	Low Intensity
Fertilizer Inputs (kg N/ha)	The Fertilizer Inputs Indicator measures the relative rate of nitrogen applied as commercial fertilizer by watershed between 2001 and 2006.	> 45.50 kg N/ha		< 31.26 kg N/ha
Fertilizer Inputs (kg P/ha)	The Fertilizer Inputs Indicator measures the relative rate of phosphorus applied as commercial fertilizer by watershed between 2001 and 2006.	> 8.50 kg P/ha		< 5.95 kg P/ha
Pesticide Inputs	The Pesticide Inputs Indicator measures the intensity of pesticide use by watershed between 2001 and 2006.	> $49.71/hectare		< $39.35/ hectare
Density of Pesticide Permits	This indicator measures the density of pesticide permits issued between April 1, 2008 and March 31, 2009, by the Saskatchewan Ministry of Agriculture within each watershed.	> 19		< 4
Total Manure Production by Livestock	This indicator measures the total amount of manure produced by watershed.	> 1,628 kg/ha		< 1,098 kg/ha
Nitrogen production in Livestock Manure	This indicator measures the amount of nitrogen produced in livestock manure by watershed.	> 9.99 kg/ha		< 7 kg/ha
Phosphorus Production in Livestock Manure	This indicator measures the amount of phosphorus produced in livestock manure by watershed.	> 2.99	2 to 2.99 kg/ha	< 2 kg/ha
Wetland Loss	This indicator estimates the area of wetland loss by watershed between 1985 and 1999.	> 14%	5% and 14%	< 5%
Density of Oil and Gas Spills	The Density of Oil and Gas Spills Indicator is a measurement of the annual number of oil and gas spills per 1,000 square kilometres.	≥ 5 spills/1,000 km²		< 1 spills/1,000 km²
Annual Volume of Oil and Emulsion Spills	The Volume of Oil and Emulsion Spills Indicator is a measure of the average annual volume of oil and emulsion spills per square kilometre.	> 100 litres/km²		< 10 litres/km²
Annual Volume of Saltwater Spills	This indicator measures the average annual volume of saltwater spills per square kilometre.	> 100 litres/km²		< 10 litres/km²
Mine Density	This indicator compares the density of active, inactive and abandoned mines within and between watersheds.	> 10 mines/1,000 km²		< 3 mines/1,000 km²
Potential Environmental Risk of Mines	This indicator measures the stress that active, inactive and abandoned mines are placing on the environment.	> 10		< 3
Percent of Forested Area Disturbed in Last 14 Years	This indicator measures the percent of forested area that has been disturbed by human activities and wildfire within watersheds over the past 14 years (1994-2007).	> 46.48%		< 18.67%
Environmental Risk of Contaminated Sites	This indicator measures the stress that contaminated sites are placing on the environment.	> 7.89	2.72 to 7.89	< 2.72
Density of Industrial Waste Sites	This indicator measures the number of industrial waste sites per 1,000 square kilometres.	> 3.38/1,000 km²	1.20 to 3.38 /1,000 km²	< 1.20 /1,000 km²
Industrial Waste Disposed and Released	This indicator measures the tonnes of pollutants disposed of and released from industrial waste sites per square kilometre in Saskatchewan.	> 5.45 tonnes/km²	1.48 to 5.45 tonnes/km²	< 1.48 tonnes/km²

Table 1. Select criteria to assign watershed health grades to Stressor, Condition, and Response indicators (cont'd).

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Beneficial Management Practices	This indicator outlines the Beneficial Management Practices that have been funded or adopted by watershed.	Yes	Yes
Watershed and Land Use Planning	This indicator assesses land use planning activities by watershed.	Yes	Yes
Water Quality Monitoring and Management	This indicator reports on the government-led water quality monitoring programs that are active by watershed.	Yes	Yes
Water Quantity Monitoring and Management	This indicator reports on the government-led water quantity monitoring programs that are active by watershed.	Yes	Yes
Protected Areas	This indicator reports on the percent of protected area by watershed.	Yes	Yes
Legislative Tools, Strategies, Policies, and Guidelines	This indicator reports on the federal and provincial legislation, strategies, policies and guidelines that have been developed to address environmental issues in Saskatchewan.	Yes	Yes

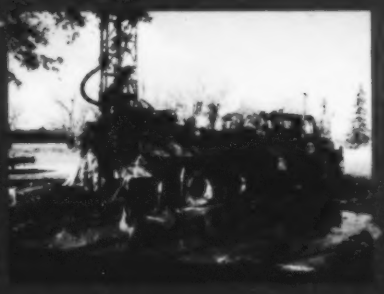
For detailed assessments of the condition, stressor and/or response indicators, see Appendices A, B, and C, respectively.

STATE OF

DEVELOPMENT OF INDICATORS

What defines an indicator?

Watershed health indicators provide a picture of a watershed's condition and/or the direction of the condition (e.g. whether the condition is getting better or worse). Indicators assist in developing an overall comprehension of more complex ecosystem processes that occur in the watershed but are difficult to measure. Indicators can show trends, measure progress, and identify problems; however, they are not designed to provide mechanistic explanations for these complex ecosystem processes, or to allow conclusions to be made about cause-and-effect relationships.



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How were the indicators selected?

A compilation of indicators were proposed by various organizations, including, but not limited to: Agriculture and Agri-Food Canada – Agri-Environment Services Branch, Environment Canada, the Saskatchewan Ministry of Environment, the Saskatchewan Ministry of Energy and Resources, the Saskatchewan Ministry of Agriculture, and Ducks Unlimited Canada. To select the best indicators, a set of criteria for good indicators was identified based in part on the criteria used in the United States Environmental Protection Agency's Index of Watershed Indicators (2002). The following criteria were used to finalize indicators for this report:

1. **Assess watershed health:** Indicators must characterize some phenomenon important to watershed health, whether it is a stressor/vulnerability, condition, or agency response.
2. **Educational:** Indicators must present this assessment in a simple, understandable way that will inspire readers to learn more about watershed health.
3. **Measure progress:** Indicators must measure progress toward the vision of safe drinking water sources and reliable water supplies for economic, environmental and social benefits for Saskatchewan people. The indicator must be able to incorporate long-term changes in watershed health.
4. **Guide more effective resource management:** Indicators must provide meaningful feedback and general direction to water resource management agencies and stakeholders on priorities and mechanisms for effectively achieving healthier watersheds.
5. **Cost effective:** Indicators must make use of existing information and maximize data sharing, while still offering an effective assessment of watershed health.
6. **Watershed scale:** The scale at which the indicator is presented must match the scale of the phenomenon being measured.
7. **Comparable:** Indicators must allow for comparison with historic conditions and standards within a watershed, while also allowing for comparison among watersheds.

Only selecting indicators that could be estimated from currently available, complete datasets would facilitate reporting, but would only allow a limited number of indicators to be included. In order for the *State of the Watershed Report* to capture meaningful aspects of watershed health, it must make use of incomplete datasets of variable quality. The majority of the indicators presented below are based on sufficient data for presenting a broad-scale picture of watershed health.

Universally applicable indicators would likewise facilitate standardized reporting, which has a certain appeal. However, the most meaningful indicators will reflect local and regional ecological realities, and therefore be regionally specific.

Altogether, 41 indicators have been developed for this report, 37 of which have rating schemes and are being used to assess Saskatchewan watersheds. Of these 37 indicators, six are condition indicators, 22 are stressor indicators, and nine are response indicators.

A number of datasets were used to develop these indicators. Some datasets were updated from the 2007 *State of the Watershed Report*, such as the 2006 Census of Canada data and the 2006 Census of Agriculture data, and some new datasets were also sourced.

Not all 37 indicators were available and/or applicable for each of Saskatchewan's 29 watersheds. The Assiniboine River and North Saskatchewan River Watersheds are the only two watersheds where all of the 37 indicators were applicable and datasets were available. Data was available for, on average, 20 of the 37 indicators (54%) for the seven northern watersheds (including the Athabasca River, Black Lake,

Churchill River, Kasba Lake, Lake Athabasca, Reindeer River/Wollaston Lake, and Tazin River Watersheds). For the northern watersheds where an indicator could not be calculated, on average, 11 of the 37 indicators were not applicable to these watersheds, and data was unavailable for, on average, six of the 37 indicators. For the remaining twenty watersheds, on average, 34 of the 37 indicators (91.5%) were applicable and datasets were available; two of the 37 indicators did not have data available, and one of the indicators was not applicable (Figure 10).

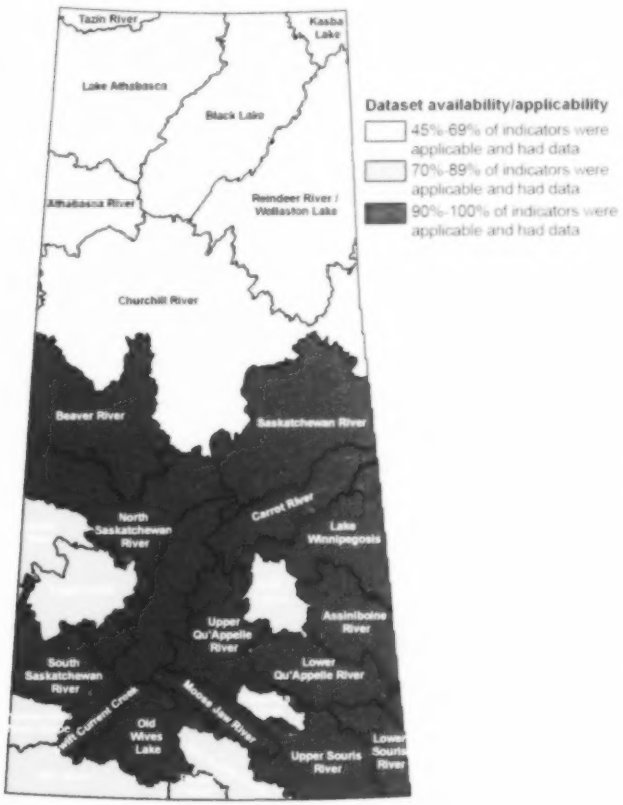

Figure 10. Indicator data availability and applicability by watershed.

Limitations

The intention of each indicator is to be representative so that areas at higher relative risk can be identified and the nature of that risk assessed. The methods used to calculate the stressor and condition indicators have several limitations, including:

- The indicators are estimates, and they should be thought of accordingly.
- The Jenks' optimization method was used to rate stressor and condition indicators when insufficient data from appropriate scientific studies existed to rate the indicator.
- The rating schemes are intended to be used to compare all watersheds within Saskatchewan. A low stress rating simply means that the watershed scored lower relative to other watersheds in Saskatchewan based on the criteria being rated.
- The natural breaks (ratings) of the Jenks' optimization method may change as more data are included.

Again, it is important to note that the stress rating does not reflect the health of a watershed. The existence of a stressor does not mean that the health of the watershed is impacted; it implies that there is a potential for it to be impacted. Stress ratings are relative measures and are designed to provide information on the potential stress levels of the activity in the watershed, relative to other watersheds in the province.

Development of Additional Indicators

The development of indicators is a dynamic process. The Saskatchewan Watershed Authority will continue to develop indicators to assist in its efforts to manage and protect source water.

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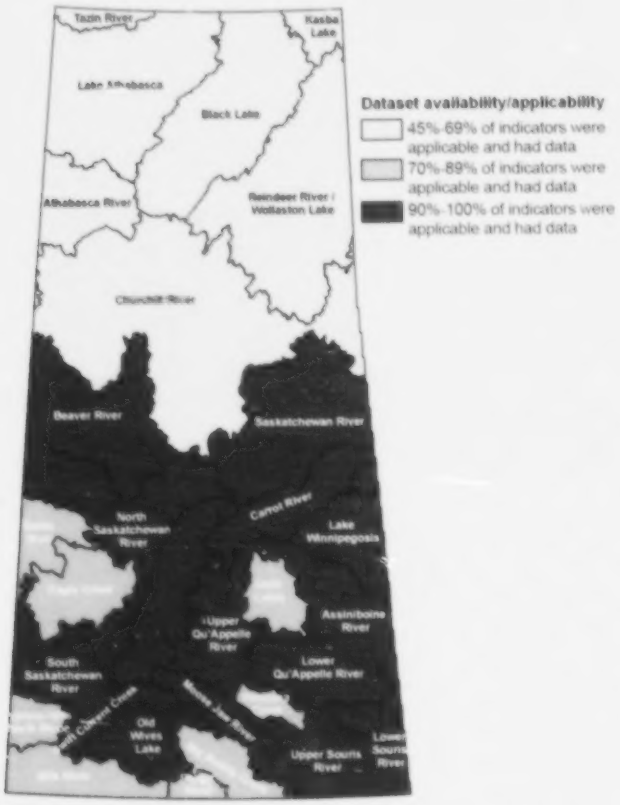

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Development of Additional Indicators

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STATE OF

TRENDS IN THE HEALTH OF SASKATCHEWAN'S WATERSHEDS

The State of the Watershed Reporting process was designed to provide regular updates on watershed health and allow for the assessment of changes within and among watersheds over time. In the 2010 *State of the Watershed Report*, a number of core condition indicators from the 2007 *State of the Watershed Report* were revised and fine-tuned to provide a more accurate and precise evaluation of the ecological services water is providing at the watershed level. Due to these changes, the ratings for these indicators from the 2007 *State of the Watershed Report* cannot be directly compared to the ratings in this report. For this reason, trends in watershed health could not be analyzed by directly comparing the two reports.

THE WATERSHED

4.0

Rather, trends in watershed health were analyzed by applying the revised methods to the most recent ten years of data (1999-2008) that was available. The data were then broken into two five-year increments (1999-2003 and 2004-2008). Using the same methodology to produce watershed health ratings for these indictors enabled the ratings for the two time periods to be directly compared to one another, and this made it possible to assess changes in watershed health over time. The two five-year rolling averages were used to buffer out the seasonal and annual variation of some of the indicators.

The overall health ratings, as shown in the watershed report card, remained constant for 23 of the 29 watersheds between 1999-2003 and 2004-2008. The Assiniboine River, Big Muddy Creek, Cypress Hills North Slope, Moose Jaw River, Poplar River and Wascana Creek Watersheds are the six watersheds that had different health ratings between the two time periods.

Six condition indicators are used to calculate the health rating of watersheds. These include the Surface Water Quality, Ground Water Quality, Aquatic Benthic Macroinvertebrates, Riparian Areas, Rangeland Areas and Environmental Acidification Indicators.

Trends in the Surface Water Quality Indicator

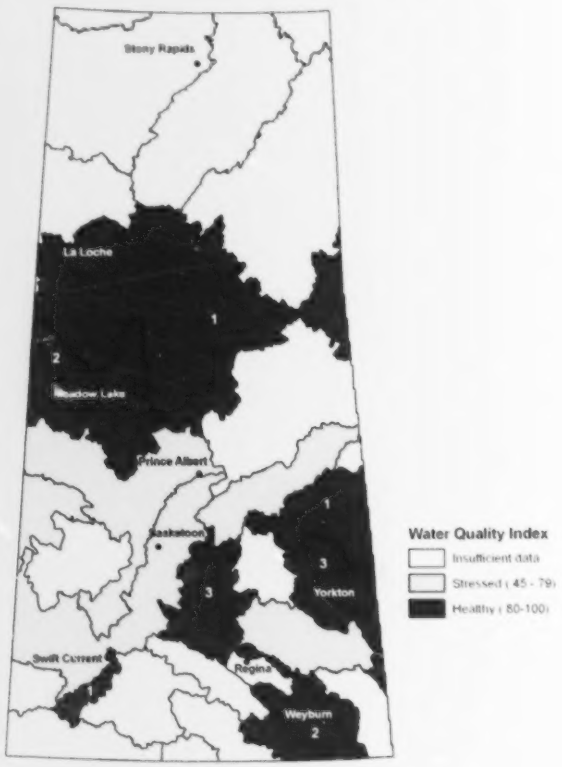

Figure 11. Five-year average of Water Quality Index Values: 1999-2003.

Note: numbers within the watershed boundaries represent the number of sites with WQI values that were used to calculate the five year average WQI value for the watershed.

THE WATERSHED

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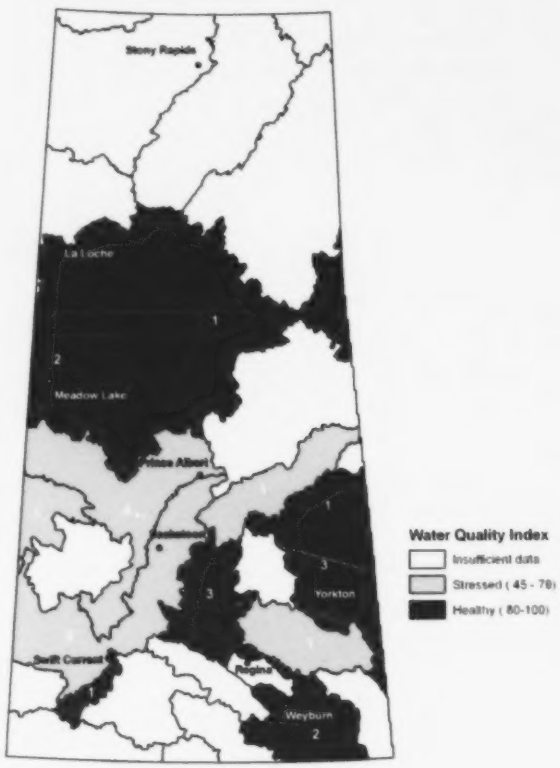

Figure 11. Five-year average of Water Quality Index Values: 1999-2003.

Note: numbers within the watershed boundaries represent the number of sites with WQI values that were used to calculate the five-year average WQI value for the watershed.

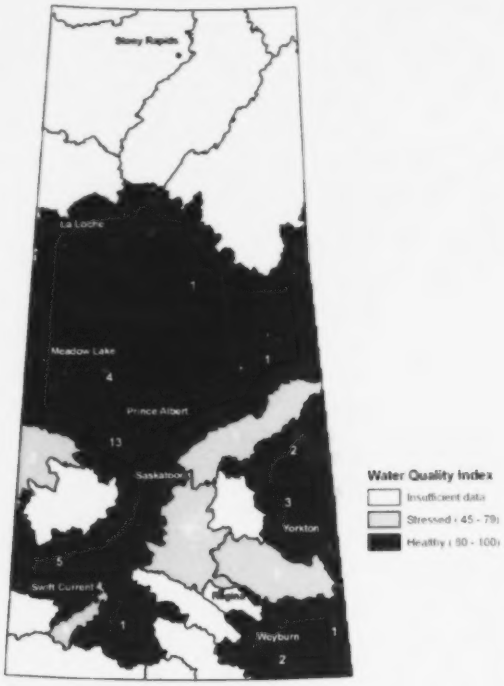

Figure 12. Four-year average of Water Quality Index Values: 2004-2007.

Note: numbers within the watershed boundaries represent the number of sites with WQI values that were used to calculate the four-year average WQI value for the watershed.

Trends in the Surface Water Quality Indicator between 1999-2003 and 2004-2007 (Figures 11 and 12) include:

- The total number of water quality samples used to calculate the Water Quality Index increased from 22 to 56;
- The number of watersheds with Water Quality Index values increased from 12 to 15; and
- The average Water Quality Index values increased for two watersheds and declined for two of the 11 watersheds that had water Quality Index values in both time periods (1999-2003 and 2004-2007).

Water Quality Index values change as a consequence of improved water quality; however, watershed health values are also dependent upon the number and location of monitoring sites and the frequency of sampling.

Trends in the Ground Water Quality Indicator

The Ground Water Quality indicator is a new indicator for the 2010 Report. As such, it was not reported on in the 2007 *State of the Watershed Report*. Trends in ground water quality cannot be assessed at specific locations, as very few wells in the province are tested more than once. However, trends in ground water quality can be assessed by examining the change in the percentage of wells that exceed at least one human-influenced Maximum Acceptable Concentration (according to Health Canada's Drinking Water Quality Standards and Guidelines) between two time periods. To assess this, the percentage of wells sampled between 1999 and 2003 that exceeded at least one human-influenced Maximum Acceptable Concentration was compared to the percentage of wells that were sampled between 2004 and 2008 that exceeded at least one human-influenced Maximum Acceptable Concentration (Figures 13 and 14).

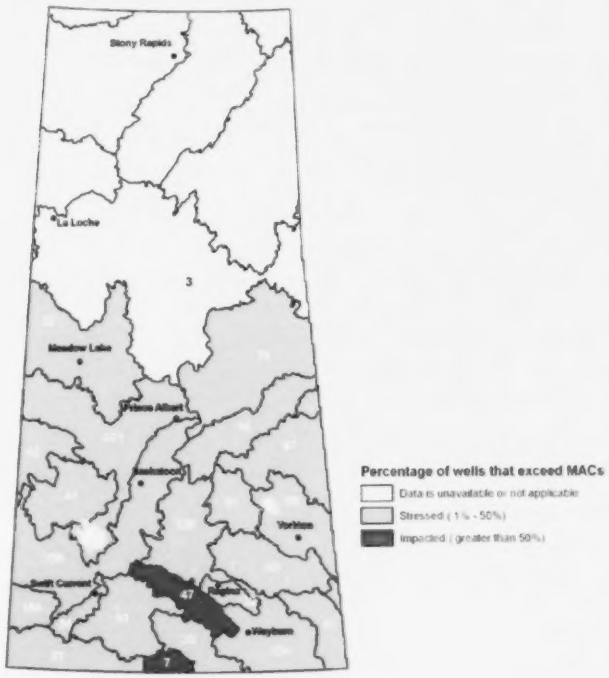

Figure 13. Percentage of wells sampled between 1999 and 2003 that exceed at least one human-influenced* Maximum Acceptable Concentration

*Human-influenced Maximum Acceptable Concentrations include nitrate (NO_3^-), total coliform bacteria, and *Escherichia coliform* (*E. coli*) bacteria.
Note: numbers within the watershed boundaries represent the number of ground water wells sampled through the Rural Water Quality Advisory Program.

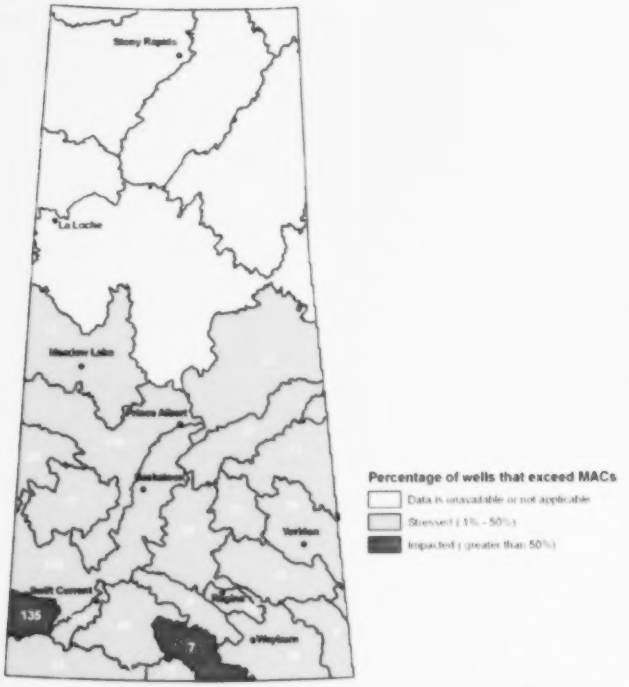

Figure 14. Percentage of wells sampled between 2004 and 2008 that exceed at least one human-influenced* Maximum Acceptable Concentration

*Human-influenced Maximum Acceptable Concentrations include nitrate (NO_3^-), total coliform bacteria, and *Escherichia coliform (E. coli)* bacteria.
Note: numbers within the watershed boundaries represent the number of ground water wells sampled through the Rural Water Quality Advisory Program.

The differences in the Ground Water Quality Indicator based on the percentage of wells that exceed human-influenced MACs between 1999 and 2003 and 2004 and 2008 (Figures 13 and 14) include:

- the total number of wells sampled between these two time periods differed. Between 1999 and 2003, 1,859 wells were sampled, compared to 1,143 wells sampled between 2004 and 2008 time period;
- the number of wells sampled between these two time periods differed by watershed (see the white numbers within Figures 13 and 14);
- ground water wells in the Churchill River Watershed were sampled three times in the 1999-2003 time period, but they were not sampled during the 2004-2008 time period;
- the Moose Jaw River and Poplar River Watersheds had at least one human-influenced MAC exceedance in more than 50% of the wells sampled between 1999 and 2003 (Figure 13), compared to 25% and 27%, respectively, in the 2004-2008 time period (Figure 14); and
- the Cypress Hills North Slope and Big Muddy Creek Watersheds had at least one human-influenced MAC exceedance in more than 50% of the wells sampled between 2004 and 2008 (Figure 14), compared to 47% and 33%, respectively, in the 1999-2003 time period (Figure 13).

Trends in the Aquatic Benthic Macroinvertebrates Indicator

The Aquatic Benthic Macroinvertebrates Indicator is a new indicator for the 2010 Report. As such, it was not reported on in the 2007 *State of the Watershed Report*. Currently, trends in this indicator cannot be assessed, as only two years of data has been collected and analyzed. However, aquatic benthic macroinvertebrate data are continuing to be collected and trends will be analyzed in future State of the Watershed Reports.

Trends in the Riparian Areas Indicator

The Riparian Areas Indicator assesses both the riparian health and riparian buffer within Saskatchewan's watersheds.

Riparian Health

Trends in riparian health cannot be assessed on a site-by-site basis since very few riparian areas in the province are sampled more than once and the site selection process is typically project-related. As with other trend assessments, differences in the average riparian health by watershed were assessed between two time periods. To do so, the average health of riparian areas that were sampled between 1999 and 2003 was compared to the average health of riparian areas that were sampled between 2004 and 2008 (Figures 15 and 16).

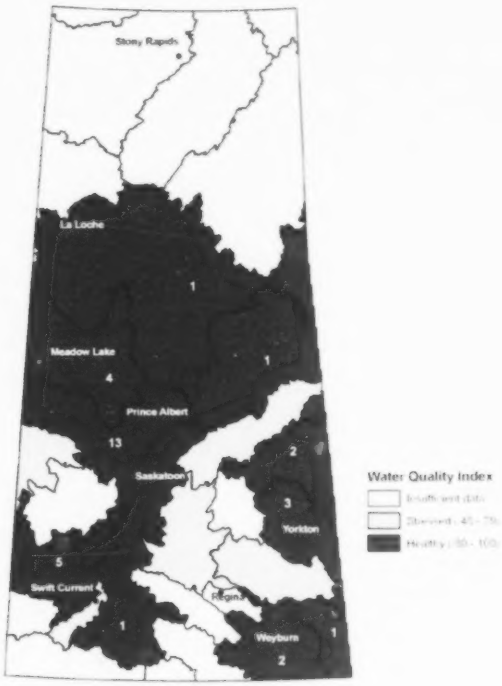

Figure 12. Four-year average of Water Quality Index Values: 2004-2007.

Note: numbers within the watershed boundaries represent the number of sites with WQI values that were used to calculate the four-year average WQI value for the watershed.

Trends in the Surface Water Quality Indicator between 1999-2003 and 2004-2007 (Figures 11 and 12) include:

- The total number of water quality samples used to calculate the Water Quality Index increased from 22 to 56;
- The number of watersheds with Water Quality Index values increased from 12 to 15; and
- The average Water Quality Index values increased for two watersheds and declined for two of the 11 watersheds that had water Quality Index values in both time periods (1999-2003 and 2004-2007).

Water Quality Index values change as a consequence of improved water quality; however, watershed health values are also dependent upon the number and location of monitoring sites and the frequency of sampling.

Trends in the Ground Water Quality Indicator

The Ground Water Quality indicator is a new indicator for the 2010 Report. As such, it was not reported on in the 2007 *State of the Watershed Report*. Trends in ground water quality cannot be assessed at specific locations, as very few wells in the province are tested more than once. However, trends in ground water quality can be assessed by examining the change in the percentage of wells that exceed at least one human-influenced Maximum Acceptable Concentration (according to Health Canada's Drinking Water Quality Standards and Guidelines) between two time periods. To assess this, the percentage of wells sampled between 1999 and 2003 that exceeded at least one human-influenced Maximum Acceptable Concentration was compared to the percentage of wells that were sampled between 2004 and 2008 that exceeded at least one human-influenced Maximum Acceptable Concentration (Figures 13 and 14).

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Trends in the Aquatic Benthic Macroinvertebrates Indicator

The Aquatic Benthic Macroinvertebrates Indicator is a new indicator for the 2010 Report. As such, it was not reported on in the 2007 *State of the Watershed Report*. Currently, trends in this indicator cannot be assessed, as only two years of data has been collected and analyzed. However, aquatic benthic macroinvertebrate data are continuing to be collected and trends will be analyzed in future State of the Watershed Reports.

Trends in the Riparian Areas Indicator

The Riparian Areas Indicator assesses both the riparian health and riparian buffer within Saskatchewan's watersheds.

Riparian Health

Trends in riparian health cannot be assessed on a site-by-site basis since very few riparian areas in the province are sampled more than once and the site selection process is typically project-related. As with other trend assessments, differences in the average riparian health by watershed were assessed between two time periods. To do so, the average health of riparian areas that were sampled between 1999 and 2003 was compared to the average health of riparian areas that were sampled between 2004 and 2008 (Figures 15 and 16).

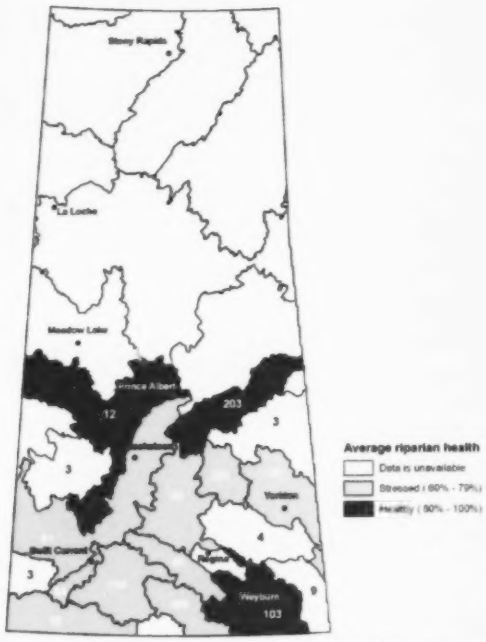


Figure 15. Five-year average riparian health values: 1999-2003.

Note: the numbers shown within the watersheds are the number of assessments used to calculate the average riparian health assessment scores. The riparian health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

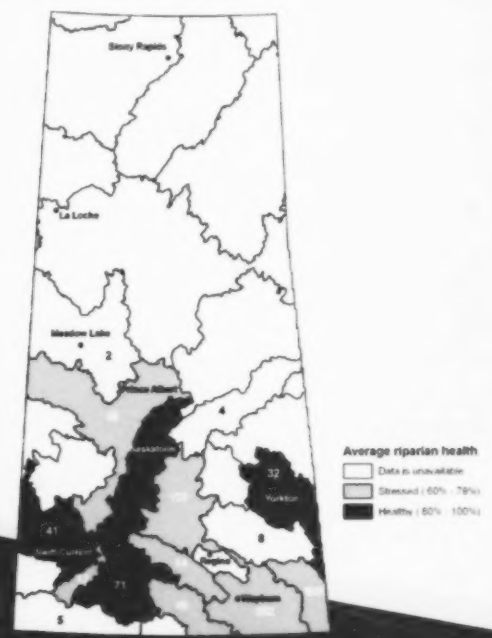


Figure 16. Five-year average riparian health values: 2004-2008.

Note: the numbers shown within the watersheds are the number of assessments used to calculate the average riparian health assessment scores. The riparian health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

Differences in the average riparian health value between 1999-2003 and 2004-2008 (Figures 15 and 16) include:

- the number of riparian assessments conducted between 1999-2003 was 1,327 (181 lotic and 1,146 lentic assessments) in 17 watersheds compared to 1,347 assessments (479 lotic and 868 lentic) conducted in 14 watersheds between 2004 and 2008; and
- the condition rating for the nine watersheds that had riparian health values in both time periods improved for three watersheds, decreased for two watersheds and remained constant for the other four watersheds.

Average riparian health values change as a consequence of improved riparian health; however, values are also dependent upon the number and location of assessment sites.

Figure 17. Percent of permanent cover within a 40 metre buffer of a waterway or waterbody: 1993/1994.

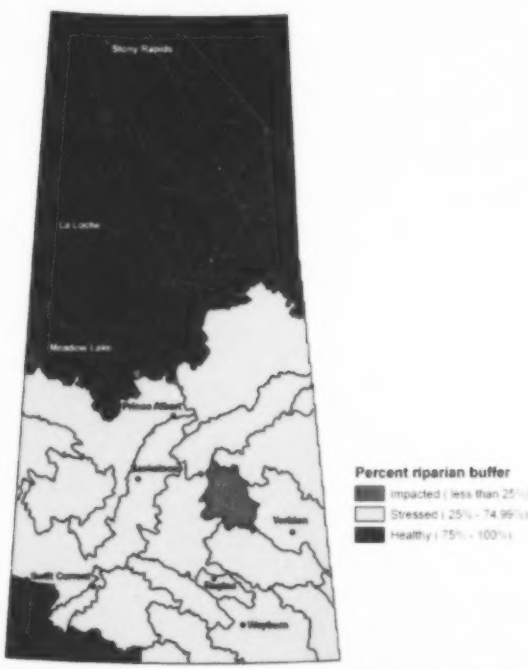
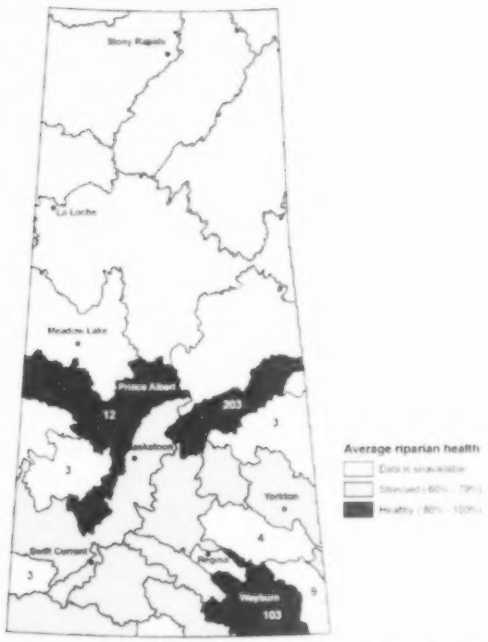


Figure 18. Percent of permanent cover within a 40 metre buffer of a waterway or waterbody: 2001.

Riparian Buffer

The differences between the percent of permanent cover adjacent to waterways in 1993-1994 and 2001 (Figures 17 and 18) include:

- the health of Saskatchewan River Watershed decreased from healthy to stressed; and
- the percent riparian buffer width for Wascana Creek Watershed increased, improving its ranking from impacted to stressed.



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Note: the numbers shown within the watersheds are the number of assessments used to calculate the average riparian health assessment scores. The riparian health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

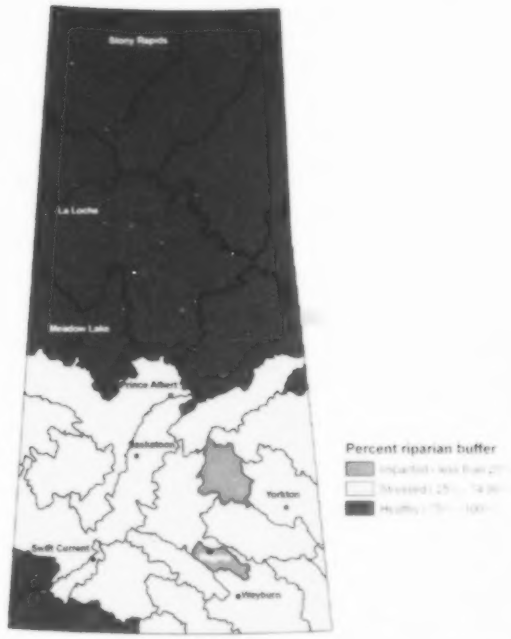
Figure 16. Five-year average riparian health values: 2004-2008.

Note: the numbers shown within the watersheds are the number of assessments used to calculate the average riparian health assessment scores. The riparian health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

Differences in the average riparian health value between 1999-2003 and 2004-2008 (Figures 15 and 16) include:

- the number of riparian assessments conducted between 1999-2003 was 1,327 (181 lotic and 1,146 lentic assessments) in 17 watersheds compared to 1,347 assessments (479 lotic and 868 lentic) conducted in 14 watersheds between 2004 and 2008; and
- the condition rating for the nine watersheds that had riparian health values in both time periods improved for three watersheds, decreased for two watersheds and remained constant for the other four watersheds.

Average riparian health values change as a consequence of improved riparian health; however, values are also dependent upon the number and location of assessment sites.



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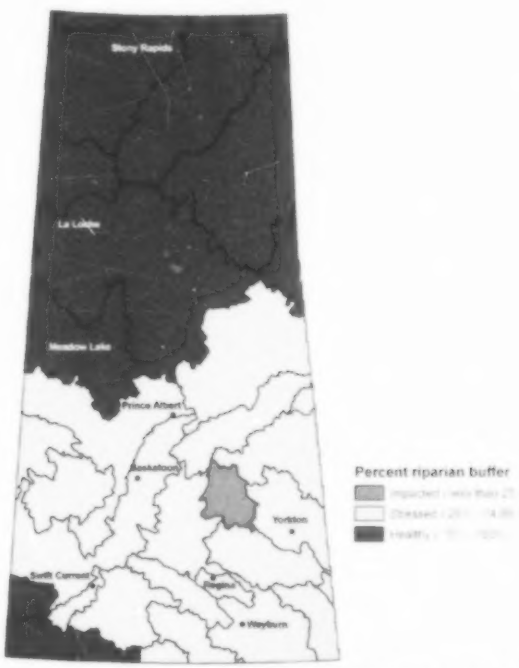

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- the health of Saskatchewan River Watershed decreased from healthy to stressed; and
- the percent riparian buffer width for Wascana Creek Watershed increased, improving its ranking from impacted to stressed.

Figure 19. Five-year average range health values: 1999-2003.

Note: the numbers shown within the watersheds are the number of assessments used to calculate the average rangeland health assessment scores. The rangeland health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

Figure 20. Five-year average range health values: 2004-2008.

Note: the numbers shown within the watersheds are the number of assessments used to calculate the average rangeland health assessment scores. The rangeland health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

Trends in the Rangeland Health Indicator

Trends in rangeland health in Saskatchewan were assessed by examining differences in the average rangeland health by watershed between two time periods. This assessment compared the average health of rangeland areas that were sampled between 1999 and 2003 to the average health of rangeland areas that were sampled between 2004 and 2008 (Figures 19 and 20).

Differences in the average rangeland health assessment values between 1999-2003 and 2004-2008 (Figures 19 and 20), include:

- the number of rangeland health assessments conducted between 1999-2003 was 1,005 (885 native rangeland and 120 tame rangeland assessments) in 10 watersheds, compared to the 1,507 assessments (1,201 native rangeland and 306 tame rangeland assessments) conducted between 2004 and 2008 in 16 watersheds; and
- the average range score for the six watersheds that had riparian health values in both time periods decreased for one watershed and remained constant for the other five watersheds.

The average range score changes as a consequence of improved range health; however, values are also dependent upon the number and location of the sites assessed.

Trends in the Environmental Acidification Indicator

Currently, trends in the impact of acid deposition in Saskatchewan cannot be assessed, as data are still being gathered. In 2005, according to the Executive Summary of the *Canadian Acid Deposition Science Assessment 2004* report, insufficient data were available to determine the extent of effects of acid deposition on northern Saskatchewan ecosystems. Since the *Canadian Acid Deposition Science Assessment 2004* was released, additional data have been collected by both provincial and federal governments to allow Critical Load Exceedances to be estimated for northern Saskatchewan. This updated data is used to calculate the Environmental Acidification Indicator in this report. The Environmental Acidification Indicator reveals that the Athabasa River Watershed is the only watershed in Saskatchewan currently rated as stressed due to acid deposition. It is not currently possible to state at what timeframe the health of this watershed has changed. However, data are continuing to be collected and trends will be analyzed in future State of the Watershed Reports.

Changes in the Condition Report Card

To allow trends in watershed health to be assessed in this Report, the updated data and revised methods from this report were used to reanalyze the condition indicators using data from the most recent 10 years, based on two five-year time increments.

Six condition indicators with rating schemes are used to calculate the 2010 Watershed Health Report Card. These include the Surface Water Quality, Ground Water Quality, Aquatic Benthic Macroinvertebrates, Riparian Areas, Rangeland Areas and Environmental Acidification Indicators. Given data availability, trends in the Aquatic Benthic Macroinvertebrates and Environmental Acidification Indicators between 1999-2003 and 2004-2008 cannot currently be assessed. Therefore, to assess changes in the health of watersheds between 1999-2003 and 2004-2008 (Figures 21 and 22), the condition report card is calculated using only the Surface Water Quality, Ground Water Quality, Riparian Areas, and Rangeland Areas Indicators.

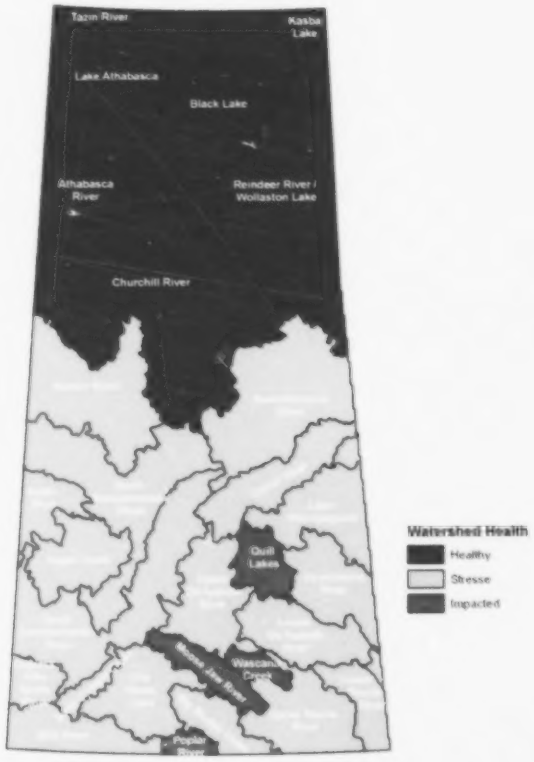

Figure 21. Health of watersheds based on condition indicators: 1999-2003.

Figure 19. Five-year average range health values: 1999-2003.

Note: the numbers shown within the watersheds are the number of assessments used to calculate the average rangeland health assessment scores. The rangeland health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

Figure 20. Five-year average range health values: 2004-2008.

Note: the numbers shown within the watersheds are the number of assessments used to calculate the average rangeland health assessment scores. The rangeland health assessment scores for watersheds with fewer than 10 assessments were not averaged across the watershed.

Trends in the Rangeland Health Indicator

Trends in rangeland health in Saskatchewan were assessed by examining differences in the average rangeland health by watershed between two time periods. This assessment compared the average health of rangeland areas that were sampled between 1999 and 2003 to the average health of rangeland areas that were sampled between 2004 and 2008 (Figures 19 and 20).

Differences in the average rangeland health assessment values between 1999-2003 and 2004-2008 (Figures 19 and 20), include:

- the number of rangeland health assessments conducted between 1999-2003 was 1,005 (885 native rangeland and 120 tame rangeland assessments) in 10 watersheds, compared to the 1,507 assessments (1,201 native rangeland and 306 tame rangeland assessments) conducted between 2004 and 2008 in 16 watersheds; and
- the average range score for the six watersheds that had riparian health values in both time periods decreased for one watershed and remained constant for the other five watersheds.

The average range score changes as a consequence of improved range health; however, values are also dependent upon the number and location of the sites assessed.

Trends in the Environmental Acidification Indicator

Currently, trends in the impact of acid deposition in Saskatchewan cannot be assessed, as data are still being gathered. In 2005, according to the Executive Summary of the *Canadian Acid Deposition Science Assessment 2004* report, insufficient data were available to determine the extent of effects of acid deposition on northern Saskatchewan ecosystems. Since the *Canadian Acid Deposition Science Assessment 2004* was released, additional data have been collected by both provincial and federal governments to allow Critical Load Exceedances to be estimated for northern Saskatchewan. This updated data is used to calculate the Environmental Acidification Indicator in this report. The Environmental Acidification Indicator reveals that the Athabasa River Watershed is the only watershed in Saskatchewan currently rated as stressed due to acid deposition. It is not currently possible to state at what timeframe the health of this watershed has changed. However, data are continuing to be collected and trends will be analyzed in future State of the Watershed Reports.

Changes in the Condition Report Card

To allow trends in watershed health to be assessed in this Report, the updated data and revised methods from this report were used to reanalyze the condition indicators using data from the most recent 10 years, based on two five-year time increments.

Six condition indicators with rating schemes are used to calculate the 2010 Watershed Health Report Card. These include the Surface Water Quality, Ground Water Quality, Aquatic Benthic Macroinvertebrates, Riparian Areas, Rangeland Areas and Environmental Acidification Indicators. Given data availability, trends in the Aquatic Benthic Macroinvertebrates and Environmental Acidification Indicators between 1999-2003 and 2004-2008 cannot currently be assessed. Therefore, to assess changes in the health of watersheds between 1999-2003 and 2004-2008 (Figures 21 and 22), the condition report card is calculated using only the Surface Water Quality, Ground Water Quality, Riparian Areas, and Rangeland Areas Indicators.

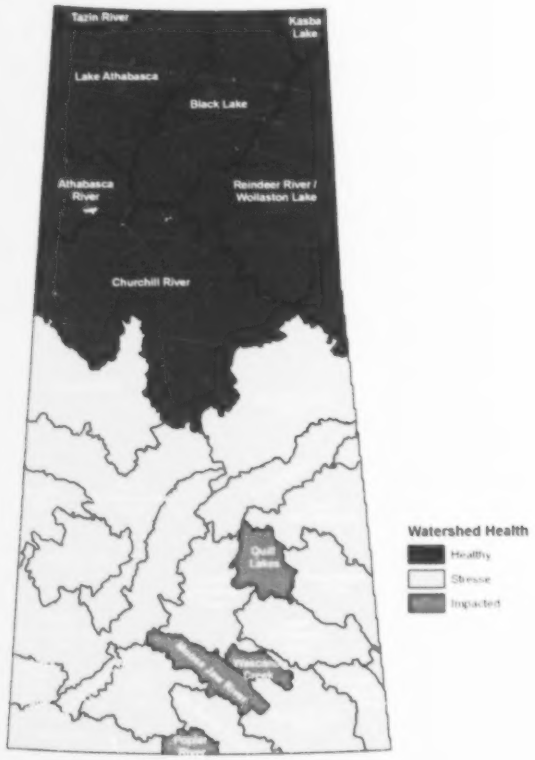

Figure 21. Health of watersheds based on condition indicators: 1999-2003.

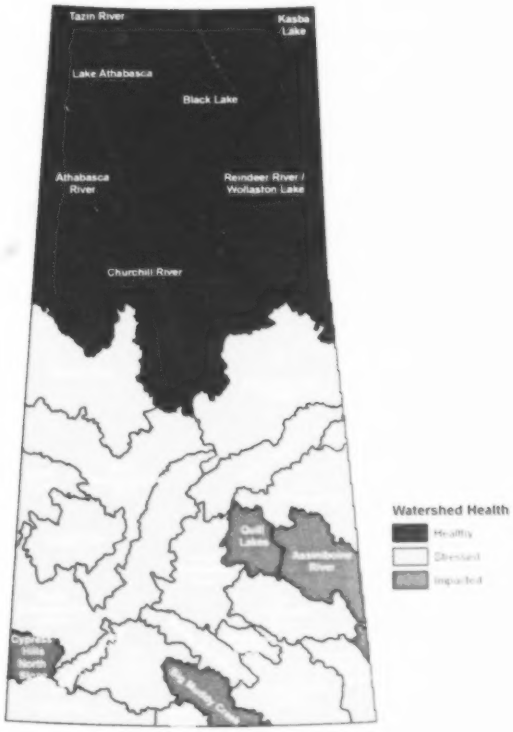

Figure 22. Health of watersheds based on condition indicators: 2004-2008.

Based on this assessment, seven of Saskatchewan's watersheds were identified as **healthy**, 18 were identified as , and four watersheds were identified as impacted in both the 1999-2003 and 2004-2008 condition report cards. The overall health of a watershed over time was determined using the lowest health rating of the four condition indicators. Therefore, a watershed is rated as impacted if at least one of the four condition indicators has a rating of impacted; stressed if the lowest rating for at least one of the four condition indicators has a rating of stressed; or as healthy if all of the four condition indicators have a rating of healthy.

Overall, health ratings between 1999-2003 and 2004-2008 (Figures 21 and 22) remained constant for twenty-three of the twenty-nine watersheds. The Quill Lakes Watershed was the only watershed identified as impacted in both condition report cards. The health rating for the Quill Lakes Watershed was based on a rating of impacted for the Riparian Areas Indicator in both timeframes, and a rating of impacted for the Rangeland Health Indicator for the 2004-2008 timeframe.

Six watersheds moved from one health category to another between the two five-year time periods, including:

- The Assiniboine River Watershed, which is categorized as stressed for 1999-2003 and impacted for 2004-2008. This change in health rating is due to the data available to rate the Rangeland Health Indicator. For the 1999-2003 period, there was insufficient data to report on the Rangeland Health Indicator for the Assiniboine River Watershed. For the 2004-2008 period, 17 rangeland health assessments were collected in the Assiniboine River Watershed, with the average rangeland health for the watershed being classified as impacted.
- The Wascana Creek Watershed, which is rated as impacted for 1999-2003 and stressed for 2004-2008. This change was due to a change in the data source used to calculate the riparian buffer component of the Riparian Areas Indicator. The percent permanent cover within a 40 meter buffer of a waterway was calculated at 23% for the 1999-2003 timeframe using the Southern Digital landcover data (classification of 1993-1994 LANDSAT-TM imagery), and at 43% for the 2004-2008 timeframe using Agriculture and Agri-Food Canada's AAFC_30m_2000 landcover data (classification of 2000 LANDSAT-TM imagery).
- The Big Muddy Creek Watershed, which is categorized as stressed in 1999-2003 and impacted in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Big Muddy Creek Watershed had at least one human-influenced MAC exceedance in more than 33% of the wells sampled between 1999 and 2003, compared to 57% in the 2004-2008 time period.
- The Cypress Hills North Slope Watershed, which is categorized as stressed in 1999-2003 and impacted in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Cypress Hills North Slope Watershed had at least one human-influenced MAC exceedance in more than 47% of the wells sampled between 1999 and 2003, compared to 53% in the 2004-2008 time period
- The Moose Jaw River Watershed, which is categorized as impacted in 1999-2003 and stressed in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Moose Jaw River Watershed had at least one human-influenced MAC exceedance in more than 55% of the wells sampled between 1999 and 2003, compared to 25% in the 2004-2008 time period.
- The Poplar River Watershed, which is categorized as impacted in 1999-2003 and stressed in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Poplar River Watershed had at least one human-influenced MAC exceedance in more than 57% of the wells sampled between 1999 and 2003, compared to 27% in the 2004-2008 time period.

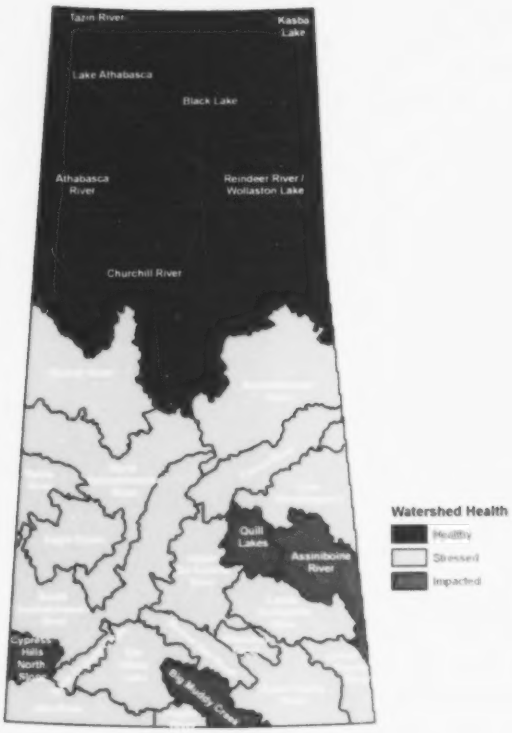

Figure 22. Health of watersheds based on condition indicators: 2004-2008.

Based on this assessment, seven of Saskatchewan's watersheds were identified as **healthy**, 18 were identified as stressed, and four watersheds were identified as impacted in both the 1999-2003 and 2004-2008 condition report cards. The overall health of a watershed over time was determined using the lowest health rating of the four condition indicators. Therefore, a watershed is rated as impacted if at least one of the four condition indicators has a rating of impacted; stressed if the lowest rating for at least one of the four condition indicators has a rating of stressed; or as healthy if all of the four condition indicators have a rating of healthy.

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Six watersheds moved from one health category to another between the two five-year time periods, including:

- The Assiniboine River Watershed, which is categorized as stressed for 1999-2003 and impacted for 2004-2008. This change in health rating is due to the data available to rate the Rangeland Health Indicator. For the 1999-2003 period, there was insufficient data to report on the Rangeland Health Indicator for the Assiniboine River Watershed. For the 2004-2008 period, 17 rangeland health assessments were collected in the Assiniboine River Watershed, with the average rangeland health for the watershed being classified as impacted.
- The Wascana Creek Watershed, which is rated as impacted for 1999-2003 and stressed for 2004-2008. This change was due to a change in the data source used to calculate the riparian buffer component of the Riparian Areas Indicator. The percent permanent cover within a 40 meter buffer of a waterway was calculated at 23% for the 1999-2003 timeframe using the Southern Digital landcover data (classification of 1993-1994 LANDSAT-TM imagery), and at 43% for the 2004-2008 timeframe using Agriculture and Agri-Food Canada's AAFC_30m_2000 landcover data (classification of 2000 LANDSAT-TM imagery).
- The Big Muddy Creek Watershed, which is categorized as stressed in 1999-2003 and impacted in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Big Muddy Creek Watershed had at least one human-influenced MAC exceedance in more than 33% of the wells sampled between 1999 and 2003, compared to 57% in the 2004-2008 time period.
- The Cypress Hills North Slope Watershed, which is categorized as stressed in 1999-2003 and impacted in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Cypress Hills North Slope Watershed had at least one human-influenced MAC exceedance in more than 47% of the wells sampled between 1999 and 2003, compared to 53% in the 2004-2008 time period
- The Moose Jaw River Watershed, which is categorized as impacted in 1999-2003 and stressed in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Moose Jaw River Watershed had at least one human-influenced MAC exceedance in more than 55% of the wells sampled between 1999 and 2003, compared to 25% in the 2004-2008 time period.
- The Poplar River Watershed, which is categorized as impacted in 1999-2003 and stressed in 2004-2008. This change in health rating is due to the Ground Water Quality Indicator. The Poplar River Watershed had at least one human-influenced MAC exceedance in more than 57% of the wells sampled between 1999 and 2003, compared to 27% in the 2004-2008 time period.

There were also a few watersheds where the overall health rating did not change between the two time periods, but the health rating for one or more of the indicators used to calculate the overall health rating did change. This can be seen in:

- The North Saskatchewan River and South Saskatchewan River Watersheds, which are both classified as having average Surface Water Quality health ratings of stressed for 1999-2003 and healthy for 2004-2007.
- The Swift Current Creek and Upper Qu'Appelle River Watersheds, which have average Surface Water Quality health ratings of healthy for 1999-2003 and stressed for 2004-2007.
- The Assiniboine River, Old Wives Lake, and South Saskatchewan River Watersheds, which have an average riparian area rating of stressed for 1999-2003 and healthy for 2004-2008.
- The North Saskatchewan River and Upper Souris River Watersheds, which have an average riparian area rating of healthy for 1999-2003 and stressed for 2004-2008.
- The Saskatchewan River Watershed, which has an average riparian buffer rating of healthy for 1999-2003 and stressed for 2004-2008.
- The Wascana Creek Watershed, which has an average riparian buffer rating of impacted for 1999-2003 and stressed for 2004-2008.
- The Quill Lakes Watershed, which has an average rangeland health assessment rating of stressed for 1999-2003 and impacted for 2004-2007.

STATE OF

RELATING WATERSHED CONDITION, STRESSOR AND RESPONSE RATINGS

Watershed footprints have been calculated in an attempt to quantitatively assess the relationship between watershed health (i.e. the condition report card results) and the stressor and response report cards. Table 2 outlines the overall condition, stress and response rating for each watershed.

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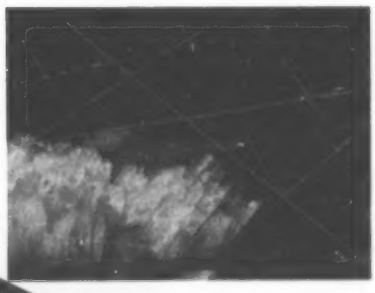
To quantify the relationship between these three ratings, the condition, stress, and response categories were all given a value between one and three. The condition categories were given a value of one for healthy, two for stressed, and three for impacted. The stressor categories were given a value of one for low intensity, two for moderate intensity, and three for high intensity. The response categories were given a value of one for high response rate, two for moderate response rate, and three for low response rate.

The assigned numbers for the condition, stressor and response values for each watershed were then summed, providing the footprint value shown in Table 2. The smaller the watershed footprint, the healthier the watershed is; the greater the watershed footprint, the unhealthier the watershed is.

The results of calculating the footprint value for each watershed show that:

- Watersheds that have a footprint value between three and four currently have management responses to mitigate the low stress levels being placed on them by human activities. Nine of the 29 watersheds (31%) have a small footprint value (between three and four) and are considered healthy.
- Watersheds with a footprint value of five to six have no or minimal degradation in function and/or the services they provide, but the watershed has lost resistance to change. Watersheds with these footprint values have management response levels that match their stress intensity levels (i.e. watersheds with moderate to high stress levels have a high response level and watersheds with low stress levels have a moderate response level). Seventeen of the 29 watersheds (58.6%) have a moderate footprint value (between five and six) and are considered stressed.
- Watersheds with a footprint value of seven have an impacted condition and the highest stress level. However, these watersheds also had a high response to mitigate these stresses and to improve the condition. Three of the 29 watersheds (10.3%) have a large footprint and are considered impacted.

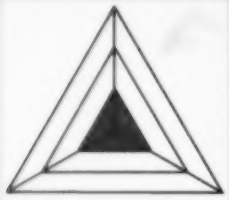
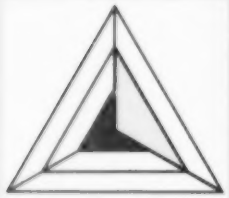
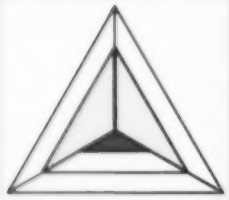
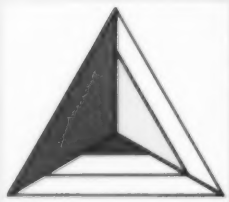
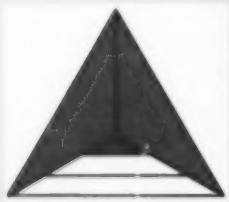


To visually represent the watershed footprints, diagrams were created using the *Stress-Condition-Response* Model template (Figure 23), as seen in the Footprint Diagram column of Table 2. To create the footprint diagram, the triangle was divided into three segments, with three levels within each segment. Segments are based on both colour and area, corresponding to the numerical values assigned to the condition, stressor and response ratings. A footprint value of one was coloured green, and its area filled the first of the three levels. A footprint value of two was coloured orange, and its area filled the first two of the three levels. A footprint value of three was coloured red, and its area filled all three levels. Therefore, the smaller and greener the watershed footprint the more healthy the watershed is, and the larger and more red the watershed footprint the more unhealthy the watershed is.

Condition
Watershed condition: defined by both structure and function of the watershed, their health or status, and how they operate together (Ambient Monitoring, Background/Baseline Monitoring, Resource Inventories)
Air, soil, water and biota exposure (Ambient Monitoring)
MONITORING PYRAMID
Resistance and resilience of a system to disturbance (Effects and Cumulative Effects Monitoring)
Stress
Response
Management objectives for activities (Compliance Monitoring)
Activities producing stresses — Physical, chemical and biological stressors (Emission and Stressor Monitoring).
Recovery processes, societal response, agencies' responses (Performance Monitoring)

Figure 23. *Stress-Condition-Response* Model demonstrating the relationship between various watershed health components.

Table 2. Watershed Condition, Stressor and Response Ratings

Watershed	Condition	Stressor	Response	Footprint value	
Black Lake	Healthy	Low Intensity	High Response	3	
Churchill River	Healthy	Low Intensity	High Response	3	
Lake Athabasca	Healthy	Low Intensity	High Response	3	
Reindeer River/ Wollaston Lake	Healthy	Low Intensity	High Response	3	
Athabasca River	Stressed	Low Intensity	High Response	4	
Kasba Lake	Healthy	Low Intensity	Moderate Response	4	
Milk River	Stressed	Low Intensity	High Response	4	
Saskatchewan River	Stressed	Low Intensity	High Response	4	
Tazin River	Healthy	Low Intensity	Moderate Response	4	
Battle River	Stressed	Moderate Intensity	High Response	5	
Beaver River	Stressed	Moderate Intensity	High Response	5	
Big Muddy Creek	Stressed	Low Intensity	Moderate Response	5	
Carrot River	Stressed	Moderate Intensity	High Response	5	
Cypress Hills North Slope	Stressed	Moderate Intensity	High Response	5	
Eagle Creek	Stressed	Low Intensity	Moderate Response	5	
Lake Winnipegosis	Stressed	Moderate Intensity	High Response	5	
Lower Souris River	Stressed	Moderate Intensity	High Response	5	
North Saskatchewan River	Stressed	Moderate Intensity	High Response	5	
South Saskatchewan River	Stressed	Moderate Intensity	High Response	5	
Swift Current Creek	Stressed	Moderate Intensity	High Response	5	
Upper Qu'Appelle River	Stressed	Moderate Intensity	High Response	5	
Lower Qu'Appelle River	Stressed	High Intensity	High Response	6	
Old Wives Lake	Stressed	High Intensity	High Response	6	
Poplar River	Stressed	High Intensity	High Response	6	
Quill Lakes	Impacted	Moderate Intensity	High Response	6	
Upper Souris River	Stressed	High Intensity	High Response	6	
Assiniboine River	Impacted	High Intensity	High Response	7	
Moose Jaw River	Impacted	High Intensity	High Response	7	
Wascana Creek	Impacted	High Intensity	High Response	7	

To visually represent the watershed footprints, diagrams were created using the *Stress-Condition-Response* Model template (Figure 23), as seen in the Footprint Diagram column of Table 2. To create the footprint diagram, the triangle was divided into three segments, with three levels within each segment. Segments are based on both colour and area, corresponding to the numerical values assigned to the condition, stressor and response ratings. A footprint value of one was coloured green, and its area filled the first of the three levels. A footprint value of two was coloured orange, and its area filled the first two of the three levels. A footprint value of three was coloured red, and its area filled all three levels. Therefore, the smaller and greener the watershed footprint the more healthy the watershed is, and the larger and more red the watershed footprint the more unhealthy the watershed is.

Condition
Watershed condition: defined by both structure and function of the watershed, their health or status, and how they operate together (Ambient Monitoring, Background/Baseline Monitoring, Resource Inventories)
Air, soil, water and biota exposure (Ambient Monitoring)
MONITORING PYRAMID
Resistance and resilience of a system to disturbance (Effects and Cumulative Effects Monitoring)
Stress
Response
Management objectives for activities (Compliance Monitoring)
Activities producing stresses — Physical, chemical and biological stressors (Emission and Stressor Monitoring).
Recovery processes, societal response, agencies' responses (Performance Monitoring)

Figure 23. *Stress-Condition-Response* Model demonstrating the relationship between various watershed health components.

Table 2. Relating Watershed Condition, Stressor and Response Ratings.

Watershed	Condition	Stressor	Response	Footprint value	
Black Lake	Healthy	Low Intensity	High Response	3	
Churchill River	Healthy	Low Intensity	High Response	3	
Lake Athabasca	Healthy	Low Intensity	High Response	3	
Reindeer River/ Wollaston Lake	Healthy	Low Intensity	High Response	3	
Athabasca River		Low Intensity	High Response	4	
Kasba Lake	Healthy	Low Intensity		4	
Milk River		Low Intensity	High Response	4	
Saskatchewan River		Low Intensity	High Response	4	
Tazin River	Healthy	Low Intensity		4	
Battle River			High Response	5	
Beaver River			High Response	5	
Big Muddy Creek		Low Intensity		5	
Carrot River			High Response	5	
Cypress Hills North Slope			High Response	5	
Eagle Creek		Low Intensity		5	
Lake Winnipegosis			High Response	5	
Lower Souris River			High Response	5	
North Saskatchewan River			High Response	5	
South Saskatchewan River			High Response	5	
Swift Current Creek			High Response	5	
Upper Qu'Appelle River			High Response	5	
Lower Qu'Appelle River		High Intensity	High Response	6	
Old Wives Lake		High Intensity	High Response	6	
Poplar River		High Intensity	High Response	6	
Quill Lakes	Impacted		High Response	6	
Upper Souris River		High Intensity	High Response	6	
Assiniboine River	Impacted	High Intensity	High Response	7	
Moose Jaw River	Impacted	High Intensity	High Response	7	
Wascana Creek	Impacted	High Intensity	High Response	7	

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Table 3. Watershed report card for condition indicators.

Watershed	Surface Water Quality	Ground Water Quality	Aquatic Benthic Macroinvertebrate	Riparian Areas	Rangeland Health	Environmental Acidification	Health Grade
Assiniboine River	Healthy	Stressed	Healthy	Stressed	Impacted	Healthy	Impacted
Athabasca River	NA*	NA*	NA*	Healthy	NA*	Stressed	Stressed
Battle River	Stressed	Stressed	Healthy	Stressed	NA*	NA*	Stressed
Beaver River	Healthy	Stressed	Healthy	Healthy	NA*	Healthy	Stressed
Big Muddy Creek	NA*	Stressed	NA*	Stressed	Stressed	NA*	Stressed
Black Lake	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Carrot River	Stressed	Stressed	Healthy	Stressed	Stressed	Healthy	Stressed
Churchill River	Healthy	NA*	NA*	Healthy	NA*	Healthy	Healthy
Cypress Hills North Slope	NA*	Stressed	Healthy	Stressed	Stressed	NA*	Stressed
Eagle Creek	NA*	Stressed	Healthy	Stressed	Stressed	NA*	Stressed
Kasba Lake	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Lake Athabasca	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Lake Winnipegosis	Healthy	Stressed	Healthy	Stressed	NA*	Healthy	Stressed
Lower Qu'Appelle River	Stressed	Stressed	Healthy	Stressed	NA*	NA*	Stressed
Lower Souris River	Healthy	Stressed	Stressed	Stressed	Stressed	Healthy	Stressed
Milk River	NA*	Stressed	Healthy	Stressed	Stressed	Healthy	Stressed
Moose Jaw River	NA*	Stressed	Impacted	Stressed	Stressed	NA*	Impacted
North Saskatchewan River	Healthy	Stressed	Healthy	Stressed	Stressed	Healthy	Stressed
Old Wives Lake	Healthy	Stressed	Healthy	Stressed	Stressed	NA*	Stressed
Poplar River	NA*	Stressed	Stressed	Stressed	NA*	NA*	Stressed
Quill Lakes	NA*	Stressed	Stressed	Impacted	Stressed	NA*	Impacted
Reindeer River/ Wollaston Lake	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Saskatchewan River	Healthy	Stressed	Healthy	Stressed	NA*	Healthy	Stressed
South Saskatchewan River	Healthy	Stressed	Healthy	Stressed	Stressed	NA*	Stressed
Swift Current Creek	NA*	Stressed	Healthy	Stressed	NA*	Healthy	Stressed
Tazin River	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Upper Qu'Appelle River	Stressed	Stressed	Stressed	Stressed	Stressed	NA*	Stressed
Upper Souris River	Healthy	Stressed	Stressed	Stressed	Stressed	NA*	Stressed
Wascana Creek	NA*	Stressed	Impacted	Stressed	NA*	NA*	Impacted

*NA indicates that data are either unavailable or not applicable for that watershed.

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Table 4. Watershed report card for stressor indicators.

Watershed	Surface Water Quantity	Surface Water Allocation	Ground Water Use	Human Population	Roads
Assiniboine River	Low Intensity	Low Intensity	High Intensity	Low Intensity	High Intensity
Athabasca River	Low Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
Battle River	Low Intensity	Low Intensity	High Intensity	Low Intensity	High Intensity
Beaver River	Low Intensity	Low Intensity	Low Intensity	Low Intensity	Moderate Intensity
Big Muddy Creek	Moderate Intensity	Low Intensity	Moderate Intensity	Low Intensity	High Intensity
Black Lake	Low Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
Carrot River	Low Intensity	Low Intensity	Moderate Intensity	Low Intensity	High Intensity
Churchill River	Low Intensity	Low Intensity	Low Intensity	Low Intensity	Low Intensity
Cypress Hills North Slope	High Intensity	High Intensity	Moderate Intensity	Low Intensity	High Intensity
Eagle Creek	High Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	High Intensity
Kasba Lake	Low Intensity	Low Intensity	NA*	Low Intensity	NA*
Lake Athabasca	Low Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
Lake Winnipegosis	Low Intensity	Low Intensity	Low Intensity	Low Intensity	Moderate Intensity
Lower Qu'Appelle River	Moderate Intensity	High Intensity	High Intensity	Low Intensity	High Intensity
Lower Souris River	Moderate Intensity	Low Intensity	Moderate Intensity	Low Intensity	High Intensity
Milk River	Moderate Intensity	High Intensity	Low Intensity	Low Intensity	Moderate Intensity
Moose Jaw River	High Intensity	High Intensity	Moderate Intensity	Moderate Intensity	High Intensity
North Saskatchewan River	Low Intensity	Low Intensity	High Intensity	Moderate Intensity	High Intensity
Old Wives Lake	High Intensity	High Intensity	Moderate Intensity	Low Intensity	High Intensity
Poplar River	High Intensity	High Intensity	High Intensity	Low Intensity	High Intensity
Quill Lakes	Moderate Intensity	Moderate Intensity	High Intensity	Low Intensity	High Intensity
Reindeer River/Wollaston Lake	Low Intensity	Low Intensity	Low Intensity	Low Intensity	Low Intensity
Saskatchewan River	Moderate Intensity	Low Intensity	Low Intensity	Low Intensity	Moderate Intensity
South Saskatchewan River	Moderate Intensity	Low Intensity	Moderate Intensity	High Intensity	High Intensity
Swift Current Creek	High Intensity	High Intensity	Moderate Intensity	Low Intensity	High Intensity
Tazin River	Low Intensity	Low Intensity	NA*	Low Intensity	NA*
Upper Qu'Appelle River	Moderate Intensity	High Intensity	High Intensity	Low Intensity	High Intensity
Upper Souris River	High Intensity	High Intensity	High Intensity	Low Intensity	High Intensity
Wascana Creek	Moderate Intensity	Low Intensity	High Intensity	High Intensity	High Intensity

*NA indicates that data are either unavailable or not applicable for that watershed.

STATE OF

WATERSHED REPORT CARD

Table 3. Watershed report card for condition indicators.

Watershed	Surface Water Quality	Ground Water Quality	Aquatic Benthic Macroinvertebrate	Riparian Areas	Rangeland Health	Environmental Acidification	Health Grade
Assiniboine River	Healthy		Healthy		Impacted	Healthy	Impacted
Athabasca River	NA*	NA*	NA*	Healthy	NA*		
Battle River			Healthy		NA*	NA*	
Beaver River	Healthy		Healthy	Healthy	NA*	Healthy	
Big Muddy Creek	NA*		NA*			NA*	
Black Lake	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Carrot River			Healthy			Healthy	
Churchill River	Healthy	NA*	NA*	Healthy	NA*	Healthy	Healthy
Cypress Hills North Slope	NA*		Healthy			NA*	
Eagle Creek	NA*		Healthy			NA*	
Kasba Lake	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Lake Athabasca	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Lake Winnipegosis	Healthy		Healthy		NA*	Healthy	
Lower Qu'Appelle River			Healthy		NA*	NA*	
Lower Souris River	Healthy					Healthy	
Milk River	NA*		Healthy			Healthy	
Moose Jaw River	NA*		Impacted			NA*	Impacted
North Saskatchewan River	Healthy		Healthy			Healthy	
Old Wives Lake	Healthy		Healthy			NA*	
Poplar River	NA*				NA*	NA*	
Quill Lakes	NA*			Impacted		NA*	Impacted
Reindeer River/ Wollaston Lake	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Saskatchewan River	Healthy		Healthy		NA*	Healthy	
South Saskatchewan River	Healthy		Healthy			NA*	
Swift Current Creek	NA*		Healthy		NA*	Healthy	
Tazin River	NA*	NA*	NA*	Healthy	NA*	Healthy	Healthy
Upper Qu'Appelle River						NA*	
Upper Souris River	Healthy					NA*	
Wascana Creek	NA*		Impacted		NA*	NA*	Impacted

*NA indicates that data are either unavailable or not applicable for that watershed.

Table 4. Watershed report card for stressor indicators.

Watershed	Surface Water Quantity	Surface Water Allocation	Ground Water Use	Human Population	Roads
Assiniboine River	Low Intensity	Low Intensity	High Intensity	Low Intensity	High Intensity
Athabasca River	Low Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
Battle River	Low Intensity	Low Intensity	High Intensity	Low Intensity	High Intensity
Beaver River	Low Intensity	Low Intensity	Low Intensity	Low Intensity	
Big Muddy Creek		Low Intensity		Low Intensity	High Intensity
Black Lake	Low Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
Carrot River	Low Intensity	Low Intensity		Low Intensity	High Intensity
Churchill River	Low Intensity	Low Intensity	Low Intensity	Low Intensity	Low Intensity
Cypress Hills North Slope	High Intensity	High Intensity		Low Intensity	High Intensity
Eagle Creek	High Intensity			Low Intensity	High Intensity
Kasba Lake	Low Intensity	Low Intensity	NA*	Low Intensity	NA*
Lake Athabasca	Low Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
Lake Winnipegosis	Low Intensity	Low Intensity	Low Intensity	Low Intensity	
Lower Qu'Appelle River		High Intensity	High Intensity	Low Intensity	High Intensity
Lower Souris River		Low Intensity		Low Intensity	High Intensity
Milk River		High Intensity	Low Intensity	Low Intensity	
Moose Jaw River	High Intensity	High Intensity			High Intensity
North Saskatchewan River	Low Intensity	Low Intensity	High Intensity		High Intensity
Old Wives Lake	High Intensity	High Intensity		Low Intensity	High Intensity
Poplar River	High Intensity	High Intensity	High Intensity	Low Intensity	High Intensity
Quill Lakes			High Intensity	Low Intensity	High Intensity
Reindeer River/Wollaston Lake	Low Intensity	Low Intensity	Low Intensity	Low Intensity	Low Intensity
Saskatchewan River		Low Intensity	Low Intensity	Low Intensity	
South Saskatchewan River		Low Intensity		High Intensity	High Intensity
Swift Current Creek	High Intensity	High Intensity		Low Intensity	High Intensity
Tazin River	Low Intensity	Low Intensity	NA*	Low Intensity	NA*
Upper Qu'Appelle River		High Intensity	High Intensity	Low Intensity	High Intensity
Upper Souris River	High Intensity	High Intensity	High Intensity	Low Intensity	High Intensity
Wascana Creek		Low Intensity	High Intensity	High Intensity	High Intensity

*NA indicates that data are either unavailable or not applicable for that watershed.

Table 4. Watershed report card for stressor indicators (Cont'd).

Watershed	Aquatic Fragmentation	Potential Runoff from Urban Impervious Areas	Wastewater Effluent Discharge	Landfills
Assiniboine River	Moderate Intensity	High Intensity	Low Intensity	High Intensity
Athabasca River	Low Intensity	NA*	NA*	NA*
Battle River	Low Intensity	NA*	Low Intensity	Moderate Intensity
Beaver River	Low Intensity	NA*	Low Intensity	Low Intensity
Big Muddy Creek	Low Intensity	NA*	NA*	Moderate Intensity
Black Lake	Low Intensity	NA*	Low Intensity	NA*
Carrot River	Low Intensity	NA*	Low Intensity	Moderate Intensity
Churchill River	Low Intensity	NA*	Low Intensity	Low Intensity
Cypress Hills North Slope	Moderate Intensity	NA*	Low Intensity	Low Intensity
Eagle Creek	Moderate Intensity	NA*	Moderate Intensity	Moderate Intensity
Kasba Lake	Low Intensity	NA*	NA*	NA*
Lake Athabasca	Low Intensity	NA*	Low Intensity	NA*
Lake Winnipegosis	Low Intensity	Low Intensity	Low Intensity	Moderate Intensity
Lower Qu'Appelle River	High Intensity	Low Intensity	Low Intensity	High Intensity
Lower Souris River	Moderate Intensity	NA*	Low Intensity	Moderate Intensity
Milk River	High Intensity	NA*	NA*	Low Intensity
Moose Jaw River	High Intensity	Low Intensity	Moderate Intensity	Moderate Intensity
North Saskatchewan River	Low Intensity	Low Intensity	Low Intensity	High Intensity
Old Wives Lake	High Intensity	NA*	Low Intensity	Moderate Intensity
Poplar River	Low Intensity	NA*	Low Intensity	Moderate Intensity
Quill Lakes	NA*	NA*	Low Intensity	Moderate Intensity
Reindeer River/Wollaston Lake	Low Intensity	NA*	Low Intensity	NA*
Saskatchewan River	Low Intensity	Low Intensity	Low Intensity	Low Intensity
South Saskatchewan River	Moderate Intensity	Low Intensity	Low Intensity	Moderate Intensity
Swift Current Creek	Moderate Intensity	Moderate Intensity	Low Intensity	Moderate Intensity
Tazin River	Low Intensity	NA*	NA*	NA*
Upper Qu'Appelle River	Moderate Intensity	Low Intensity	Low Intensity	High Intensity
Upper Souris River	Moderate Intensity	High Intensity	Low Intensity	Moderate Intensity
Wascana Creek	Moderate Intensity	High Intensity	High Intensity	High Intensity

*NA indicates that data are either unavailable or not applicable for that watershed.

Table 4. Watershed report card for stressor indicators (Cont'd).

Watershed	Environmental Assessments	Invasive Alien Species	Livestock	Soil Erosion	Fertilizer Inputs
Assiniboine River	Moderate Intensity	Low Intensity	High Intensity	Low Intensity	High Intensity
Athabasca River	Low Intensity	NA*	NA*	NA*	NA*
Battle River	High Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Moderate Intensity
Beaver River	Moderate Intensity	Low Intensity	Moderate Intensity	NA*	High Intensity
Big Muddy Creek	Moderate Intensity	Low Intensity	Moderate Intensity	Low Intensity	Low Intensity
Black Lake	Low Intensity	NA*	NA*	NA*	NA*
Carrot River	Moderate Intensity	Low Intensity	Moderate Intensity	NA*	High Intensity
Churchill River	Low Intensity	NA*	NA*	NA*	NA*
Cypress Hills North Slope	High Intensity	NA*	Moderate Intensity	Low Intensity	Low Intensity
Eagle Creek	Moderate Intensity	Low Intensity	Moderate Intensity	Low Intensity	Low Intensity
Kasba Lake	NA*	NA*	NA*	NA*	NA*
Lake Athabasca	Low Intensity	NA*	NA*	NA*	NA*
Lake Winnipegosis	Low Intensity	Low Intensity	Moderate Intensity	Low Intensity	High Intensity
Lower Qu'Appelle River	Moderate Intensity	Low Intensity	High Intensity	Low Intensity	High Intensity
Lower Souris River	Moderate Intensity	High Intensity	Moderate Intensity	Low Intensity	High Intensity
Milk River	Moderate Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Low Intensity
Moose Jaw River	Moderate Intensity	High Intensity	Moderate Intensity	Low Intensity	Moderate Intensity
North Saskatchewan River	Moderate Intensity	Moderate Intensity	High Intensity	Low Intensity	Moderate Intensity
Old Wives Lake	Low Intensity	High Intensity	High Intensity	Low Intensity	Low Intensity
Poplar River	Moderate Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Low Intensity
Quill Lakes	Moderate Intensity	Low Intensity	Moderate Intensity	Low Intensity	High Intensity
Reindeer River/Wollaston Lake	Low Intensity	NA*	NA*	NA*	NA*
Saskatchewan River	Low Intensity	Low Intensity	Low Intensity	NA*	High Intensity
South Saskatchewan River	High Intensity	Moderate Intensity	High Intensity	Low Intensity	Moderate Intensity
Swift Current Creek	Moderate Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Low Intensity
Tazin River	NA*	NA*	NA*	NA*	NA*
Upper Qu'Appelle River	Moderate Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Moderate Intensity
Upper Souris River	Moderate Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Moderate Intensity
Wascana Creek	High Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Moderate Intensity

*NA indicates that data are either unavailable or not applicable for that watershed.

Table 4. Watershed report card for stressor indicators (Cont'd).

Watershed	Pesticide Inputs	Manure Production	Wetland Loss	Oil and Gas Spills	Mines
Assiniboine River	High Intensity	High Intensity	Moderate Intensity	Low Intensity	Moderate Intensity
Athabasca River	NA*	NA*	NA*	Low Intensity	Low Intensity
Battle River	Moderate Intensity	Moderate Intensity	Low Intensity	High Intensity	Low Intensity
Beaver River	Moderate Intensity	High Intensity	NA*	Low Intensity	Low Intensity
Big Muddy Creek	Moderate Intensity	Moderate Intensity	Low Intensity	Low Intensity	High Intensity
Black Lake	NA*	NA*	NA*	NA*	Low Intensity
Carrot River	High Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
Churchill River	NA*	NA*	NA*	Low Intensity	Low Intensity
Cypress Hills North Slope	Moderate Intensity	High Intensity	Low Intensity	Low Intensity	Moderate Intensity
Eagle Creek	Moderate Intensity	Low Intensity	Low Intensity	Moderate Intensity	Low Intensity
Kasba Lake	NA*	NA*	NA*	NA*	Low Intensity
Lake Athabasca	NA*	NA*	NA*	NA*	Moderate Intensity
Lake Winnipegosis	High Intensity	High Intensity	NA*	Low Intensity	Low Intensity
Lower Qu'Appelle River	High Intensity	Moderate Intensity	Low Intensity	Low Intensity	Moderate Intensity
Lower Souris River	High Intensity	High Intensity	Low Intensity	Moderate Intensity	Moderate Intensity
Milk River	Moderate Intensity	Moderate Intensity	Low Intensity	Low Intensity	Moderate
Moose Jaw River	High Intensity	Low Intensity	Low Intensity	Low Intensity	Low Intensity
North Saskatchewan River	Moderate Intensity	High Intensity	Low Intensity	Moderate Intensity	Low Intensity
Old Wives Lake	Moderate Intensity	Moderate Intensity	Low Intensity	Low Intensity	Moderate Intensity
Poplar River	Moderate	High Intensity	Low Intensity	Low Intensity	High Intensity
Quill Lakes	High Intensity	Moderate Intensity	Moderate Intensity	Low Intensity	Moderate Intensity
Reindeer River/Wollaston Lake	NA*	NA*	NA*	NA*	Low Intensity
Saskatchewan River	High Intensity	Low Intensity	NA*	Low Intensity	Low Intensity
South Saskatchewan River	High Intensity	Moderate Intensity	Low Intensity	Moderate Intensity	Low Intensity
Swift Current Creek	High Intensity	Moderate Intensity	Low Intensity	Moderate Intensity	Moderate Intensity
Tazin River	NA*	NA*	NA*	NA*	Low Intensity
Upper Qu'Appelle River	High Intensity	Moderate Intensity	Low Intensity	Low Intensity	Moderate Intensity
Upper Souris River	Moderate Intensity	Moderate Intensity	Low Intensity	High Intensity	Moderate Intensity
Wascana Creek	High Intensity	Low Intensity	Moderate Intensity	Low Intensity	Moderate Intensity

*NA indicates that data are either unavailable or not applicable for that watershed.

Table 4. Watershed report card for stressor indicators (Cont'd).

Watershed	Forest Disturbance	Contaminated Sites	Industrial Waste	Stress
Assiniboine River	Low Intensity	Low Intensity	Low Intensity	High Intensity
Athabasca River	High Intensity	Low Intensity	Low Intensity	Low Intensity
Battle River	NA*	Moderate Intensity	Moderate Intensity	Moderate Intensity
Beaver River	Moderate Intensity	High Intensity	Low Intensity	Moderate Intensity
Big Muddy Creek	NA*	Low Intensity	Low Intensity	Low Intensity
Black Lake	Moderate Intensity	Low Intensity	Low Intensity	Low Intensity
Carrot River	Low Intensity	Low Intensity	Low Intensity	Moderate Intensity
Churchill River	Moderate Intensity	Moderate Intensity	Low Intensity	Low Intensity
Cypress Hills North Slope	NA*	Moderate Intensity	Moderate Intensity	Moderate Intensity
Eagle Creek	NA*	Low Intensity	Moderate Intensity	Low Intensity
Kasba Lake	Moderate Intensity	Low Intensity	Low Intensity	Low Intensity
Lake Athabasca	Moderate Intensity	Low Intensity	Low Intensity	Low Intensity
Lake Winnipegosis	Low Intensity	Low Intensity	Low Intensity	Moderate Intensity
Lower Qu'Appelle River	NA*	High Intensity	Low Intensity	High Intensity
Lower Souris River	NA*	Low Intensity	Moderate Intensity	Moderate Intensity
Milk River	NA*	Moderate Intensity	Low Intensity	Low Intensity
Moose Jaw River	NA*	Moderate Intensity	Low Intensity	High Intensity
North Saskatchewan River	Low Intensity	Moderate Intensity	Moderate Intensity	Moderate Intensity
Old Wives Lake	NA*	Low Intensity	Low Intensity	High Intensity
Poplar River	NA*	Moderate Intensity	Moderate Intensity	High Intensity
Quill Lakes	NA*	Low Intensity	Low Intensity	Moderate Intensity
Reindeer River/Wollaston Lake	Moderate Intensity	Low Intensity	Low Intensity	Low Intensity
Saskatchewan River	Low Intensity	Low Intensity	Low Intensity	Low Intensity
South Saskatchewan River	Low Intensity	Moderate Intensity	Moderate Intensity	Moderate Intensity
Swift Current Creek	NA*	Moderate Intensity	Moderate Intensity	Moderate Intensity
Tazin River	Moderate Intensity	Low Intensity	Low Intensity	Low Intensity
Upper Qu'Appelle River	NA*	Low Intensity	Low Intensity	Moderate Intensity
Upper Souris River	NA*	Moderate Intensity	High Intensity	High Intensity
Wascana Creek	NA*	High Intensity	High Intensity	High Intensity

*NA indicates that data are either unavailable or not applicable for that watershed.

Table 5. Watershed report card for response indicators.

Watershed	Water Conservation	Conservation Stewards	Stewardship Workshops	Beneficial Management Practices	Watershed and Land Use Planning
Assiniboine River	Present	Present	Present	Present	Present
Athabasca River	Present	Present	NA*	Present	Absent
Battle River	Present	Present	Present	Present	Present
Beaver River	Present	Present	Present	Present	Present
Big Muddy Creek	Present	Present	Present	Present	Absent
Black Lake	Present	NA*	NA*	Present	Present
Carrot River	Present	Present	Present	Present	Present
Churchill River	Present	NA*	NA*	Present	Present
Cypress Hills North Slope	Present	Present	Present	Present	Present
Eagle Creek	Present	Present	Present	Present	Absent
Kasba Lake	Present	NA*	NA*	Present	Absent
Lake Athabasca	Present	NA*	NA*	Present	Present
Lake Winnipegosis	Present	Present	Present	Present	Present
Lower Qu'Appelle River	Present	Present	Present	Present	Present
Lower Souris River	Present	Present	Present	Present	Present
Milk River	Present	Present	Present	Present	Absent
Moose Jaw River	Present	Present	Present	Present	Present
North Saskatchewan River	Present	Present	Present	Present	Present
Old Wives Lake	Present	Present	Present	Present	Present
Poplar River	Present	Present	Present	Present	Absent
Quill Lakes	Present	Present	Present	Present	Absent
Reindeer River / Wollaston Lake	Present	NA*	NA*	Present	Present
Saskatchewan River	Present	Present	Present	Present	Present
South Saskatchewan River	Present	Present	Present	Present	Present
Swift Current Creek	Present	Present	Present	Present	Present
Tazin River	Present	NA*	NA*	Present	Absent
Upper Qu'Appelle River	Present	Present	Present	Present	Present
Upper Souris River	Present	Present	Present	Present	Present
Wascana Creek	Present	Present	Present	Present	Present

*NA indicates that data are either unavailable or not applicable for that watershed.

Table 5. Watershed report card for response indicators (Cont'd).

Watershed	Water Quality Monitoring and Management	Water Quantity Monitoring and Management	Protected Areas	Legislative Tools	Response Rate
Assiniboine River	Present	Present	Less than 12%	Present	High
Athabasca River	Absent	Present	Present	Present	High
Battle River	Present	Present	Less than 12%	Present	High
Beaver River	Present	Present	Present	Present	High
Big Muddy Creek	Absent	Present	Less than 12%	Present	Moderate
Black Lake	Present	Present	Less than 12%	Present	High
Carrot River	Present	Present	Less than 12%	Present	High
Churchill River	Present	Present	Less than 12%	Present	High
Cypress Hills North Slope	Present	Present	Present	Present	High
Eagle Creek	Absent	Present	Less than 12%	Present	Moderate
Kasba Lake	Absent	Present	Present	Present	Moderate
Lake Athabasca	Present	Present	Less than 12%	Present	High
Lake Winnipegosis	Present	Present	Less than 12%	Present	High
Lower Qu'Appelle River	Present	Present	Less than 12%	Present	High
Lower Souris River	Present	Present	Less than 12%	Present	High
Milk River	Present	Present	Present	Present	High
Moose Jaw River	Present	Present	Less than 12%	Present	High
North Saskatchewan River	Present	Present	Present	Present	High
Old Wives Lake	Present	Present	Less than 12%	Present	High
Poplar River	Present	Present	Less than 12%	Present	High
Quill Lakes	Present	Present	Less than 12%	Present	High
Reindeer River / Wollaston Lake	Present	Present	Less than 12%	Present	High
Saskatchewan River	Present	Present	Less than	Present	High
South Saskatchewan River	Present	Present	Present	Present	High
Swift Current Creek	Present	Present	Less than 12%	Present	High
Tazin River	Absent	Present	Present	Present	Moderate
Upper Qu'Appelle River	Present	Present	Less than 12%	Present	High
Upper Souris River	Present	Present	Less than 12%	Present	High
Wascana Creek	Present	Present	Less than 12%	Present	High

Contributors include representatives from the Saskatchewan Watershed Authority, the Saskatchewan Ministry of Environment, the Saskatchewan Ministry of Agriculture, Environment Canada, the Saskatchewan Ministry of Highways and Infrastructure, Ducks Unlimited Canada, the Saskatchewan Ministry of Energy and Resources, Agriculture and Agri-Food Canada – Agri-Environment Services Branch, the Prairie Conservation Action Plan, Partners FOR the Saskatchewan River Basin, Agriculture and Agri-Food Canada, the Provincial Council of Agriculture Development and Diversification Boards for Saskatchewan Inc., and the Saskatchewan Soil Conservation Association.

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